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INSTALLATION RESTORATION PROGRAM
PHASE I: RECORDS SEARCH
SHEPPARD AFB, TEXAS

Prepared For
United States Air Force
HQ ATC/DEV
Randolph AFB, Texas
and
AFESC/DEV
Tyndall AFB, Florida

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By
ENGINEERING-SCIENCE
57 Executive Park South, N.E.
Suite 590
Atlanta, Georgia 30329

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EXECUTIVE SUMMARY

The Department of Defense (DOD) has developed a program to identify and evaluate past hazardous material disposal sites on DOD property, to control the migration of hazardous contaminants, and to control hazards to health or welfare that may result from these past disposal operations. This program is called the Installation Restoration Program (IRP). The IRP has four phases consisting of Phase I, Initial Assessment/Records Search; Phase II, Confirmation/Quantification; Phase III, Technology Base Development; and Phase IV, Operations/Remedial Actions. Engineering Science (ES) was retained by the United States Air Force to conduct the Phase I, Initial Assessment/Records Search for Sheppard AFB under Contract No. F08637-83-R0062.

INSTALLATION DESCRIPTION

Sheppard Air Force Base is located in Wichita County, Texas, four miles north of Wichita Falls and 150 miles northwest of Dallas. The surrounding area is semi-rural. The main installation comprises 5,249 acres in area. Two remote installation annexes under the jurisdiction of Sheppard AFB were also included in this study. These areas are as follows:

Lake Texoma Recreational Annex.	350 acres
Frederick, OK Municipal airport (joint use) . .	9 acres

Sheppard Field was activated in October 1941, on a 300-acre site. During World War II, basic training schools in several subject areas were conducted at Sheppard Field. The base was deactivated in August 1946, and was then reactivated in August 1948. During the period of inactivity, the facilities on base were not used. In 1949, the Airplane and Engine Mechanics School was transferred to Sheppard AFB; this school is now part of the USAF School of Applied Aerospace Sciences (SAAS). In 1958, the 494th Bombardment Wing, Strategic Air Command, was activated

as a tenant unit. This unit, composed of B-52 and KC-135 aircraft, remained at Sheppard until 1966. In October 1965 the 3637th Flying Training Squadron (Helicopter) was activated at Sheppard as a part of what is now the 80th Flying Training Wing (FTW). The 80th FTW presently conducts pilot training for 12 nations in T-37 and T-38 aircraft as part of the Euro-Nato Joint Jet Pilot Training (ENJJPT) Program. The School of Health Care Sciences conducts orientation of newly commissioned medical officers and advanced professional training for medical personnel.

ENVIRONMENTAL SETTING

The environmental setting data for Sheppard AFB indicate the following factors are important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation is 27.08 inches; the net precipitation is -36.92 inches and the 1-year 24-hour rainfall event is estimated to be 2.8 inches. These data indicate that there is little or no potential for precipitation to infiltrate the surface soils on the base. Also, there is a moderate potential for runoff and erosion.
2. The natural soils on the base are typically loam and combinations of sandy, silty, and clayey loam with low to moderate permeabilities. These data indicate that recharge by precipitation infiltrating the soils will be slow.
3. Surface water, the must important drinking water resource for the area, is controlled on base by open ditches, concrete-lined ditches, and underground storm drainage mains.
4. A seasonal, shallow and probably perched aquifer may underly the base locally. A major constituent of this unit is clay or clay-bearing materials. Ground-water, if present, may occur at depths of ten to thirty feet below land surface. The unit is underlain by even tighter, less permeable bedrock. Ground-water movement in the shallow unit likely favors the horizontal.

5. The shallow aquifer present on base is not known to be hydraulically connected to an aquifer providing potable water supplies. The shallow unit is considered to be a poor source of water.

6. No water supply wells have been identified within three miles of the base. It is possible that private supply wells could be present in the rural areas around the base. Private wells, should they exist, would be small wells probably constructed in the infiltration zone of small ponds. It is unlikely that any nearby wells could be hydraulically connected to the shallow units on base.

7. Bedrock (shale and sandstone) is present at shallow depths (less than 30 feet) and does not provide a viable aquifer in the vicinity of the base.

8. There are no federally or state listed endangered or threatened species which inhabit the base.

A review of these major findings indicates that pathways for the migration of hazardous waste-related contamination exist. Contaminants present at ground surface would likely be mobilized to local drainage alignments via the shortest flow path. The shallow perched aquifer encountered on base is primarily a clay-bearing material of low permeability which contains water only seasonally and is not known to be hydraulically connected to any other aquifers of regional significance. Movement within this unit, should contaminants gain access, would probably favor the horizontal. Since it is underlain by even tighter materials, the migration of waste-related contamination to deeper zones is considered to be unlikely.

METHODOLOGY

During the course of this project, interviews were conducted with base personnel (past and present) familiar with past waste disposal practices; file searches were performed for past hazardous waste activities; interviews were held with local, state, and federal agencies; and field and aerial surveys were conducted at suspected past hazardous

waste activity sites. Eleven sites on Sheppard AFB were identified as potentially containing hazardous contaminants and having the potential for contaminant migration resulting from past activities (Figure 1). These sites have been assessed using a Hazard Assessment Rating Methodology (HARM) which takes into account factors such as site characteristics, waste characteristics, potential for contaminant migration, and waste management practices. The details of the rating procedure e presented in Appendix G and the results of the assessment are giv in Table 1. The rating system is designed to indicate the relative ed for follow-on investigation. The sites have also been reviewed regard to future land use restrictions.

FINDINGS AND CONCLUSIONS

The following conclusions have been developed based on the results of the project team's field inspection, review of base records and files, and interviews with base personnel.

The four sites listed below were determined to have a sufficient potential for environmental contamination to warrant follow-on investigations. No sites requiring immediate removal of contaminants were found.

Waste Pits
Landfill No. 3 (including hardfill)
Fire Protection Training Area No. 3 (FPTA-3)
Fire Protection Training Area No. 1 (FPTA-1)

The remaining sites listed below were evaluated and determined to have insufficient evidence to warrant follow-on investigations.

Fire Protection Training Area No. 2 (FPTA-2)
Industrial Waste Pit
Landfill No. 1
Pesticide Spray Area
Low-Level Radioactive Waste Disposal Site in Landfill No. 3
Landfill No. 2
Low-Level Radioactive Waste Disposal Site at Waste Treatment Plant

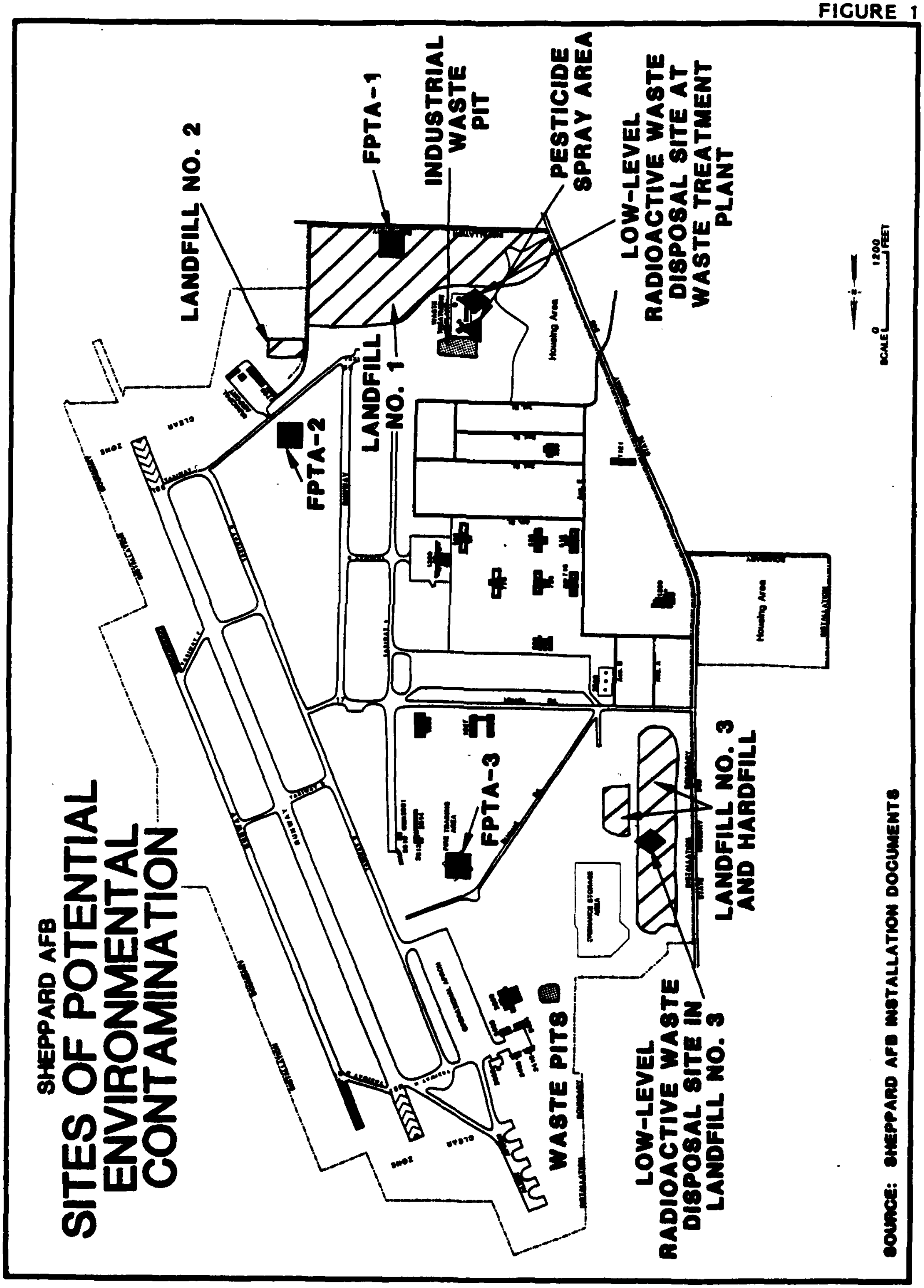

SHEPPARD AFB
SITES OF POTENTIAL ENVIRONMENTAL CONTAMINATION
LANDFILL NO. 2
FPTA-1
INDUSTRIAL WASTE PIT
PESTICIDE SPRAY AREA
LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE AT WASTE TREATMENT PLANT
LANDFILL NO. 1
FPTA-2
FPTA-3
LANDFILL NO. 3 AND HARDFILL
WASTE PITS
LOW-LEVEL RADIOACTIVE WASTE DISPOSAL SITE IN LANDFILL NO. 3
Housing Area
Housing Area
SCALE 0 1200 FEET
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

TABLE 1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY FORMS
SHEPPARD AIR FORCE BASE

Rank	Site	Operating Period	Final Harm Score
1	Waste Pits	1966 - early 1970's	58
2	Landfill No. 3 (including Hardfill)	1957 - 1972	54
3	Fire Protection Training Area No. 3	1957 - present	52
4	Fire Protection Training Area No. 1	1941 - 1957	51
5	Fire Protection Training Area No. 2	1962 - 1970	45
6	Industrial Waste Pit	1950's	39
7	Landfill No. 1	1941 - 1957	38
8	Pesticide Spray Area	1940's - present	36
9	Low-level Radioactive Waste Disposal Site in Landfill No. 3	1960's - present	31
10	Landfill No. 2	early 1960's	30
11	Low-level Radioactive Waste Disposal Site at Waste Treatment Plant	1960's - present	3

NOTE: This ranking was performed according to the Hazard Assessment Rating Methodology (HARM) described in Appendix G. Individual site rating forms are contained in Appendix H.

RECOMMENDATIONS

A program for proceeding with Phase II of the IRP at Sheppard AFB is presented in Chapter 6. The Phase II recommendations are summarized as follows:

Waste Pits - Conduct geophysical surveys; install and sample monitoring wells; sample Bear Creek (upstream and downstream of site); sample pit sediment.

Landfill No. 3 and Hardfill - Conduct geophysical surveys; install and sample monitoring wells; sample stream flowing through site (upstream and downstream of site).

Fire Protection Training Area No. 3 - Conduct geophysical surveys; install and sample monitoring wells; sample existing pond.

Fire Protection Training Area No. 1 - Conduct geophysical surveys; if surveys indicate contamination, install and sample monitoring wells; sample nearby streams and golf course ponds.

SECTION 1

INTRODUCTION

BACKGROUND AND AUTHORITY

The United States Air Force, due to its primary mission, has long been engaged in a wide variety of operations dealing with toxic and hazardous materials. Federal, state, and local governments have developed strict regulations to require that disposers identify the locations and contents of past disposal sites and take action to eliminate hazards in an environmentally responsible manner. The primary Federal legislation governing disposal of hazardous waste is the Resource Conservation and Recovery Act (RCRA) of 1976, as amended. Under Section 6003 of the Act, Federal agencies are directed to assist the Environmental Protection Agency (EPA) and under Section 3012, state agencies are required to inventory past disposal sites and make the information available to the requesting agencies. To assure compliance with these hazardous waste regulations, DOD developed the Installation Restoration Program (IRP). The current DOD IRP policy is contained in Defense Environmental Quality Program Policy Memorandum (DEQPPM) 81-5, dated 11 December 1981 and implemented by Air Force message dated 21 January 1982. DEQPPM 81-5 reissued and amplified all previous directives and memoranda on the Installation Restoration Program. DOD policy is to identify and fully evaluate suspected problems associated with past hazardous contamination, and to control hazards to health and welfare that resulted from these past operations. The IRP will be the basis for response actions on Air Force installations under the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, by Executive Order 12316, and 40 CFR 300 Subpart F (National Contingency Plan). CERCLA is the primary legislation governing remedial action at past hazardous waste disposal sites.

PURPOSE AND SCOPE OF THE ASSESSMENT

The Installation Restoration Program has been developed as a four-phased program as follows:

Phase I	- Initial Assessment/Records Search
Phase II	- Confirmation/Quantification
Phase III	- Technology Base Development
Phase IV	- Operations/Remedial Actions

Engineering-Science (ES) was retained by the United States Air Force to conduct the Phase I Records Search at Sheppard Air Force Base under Contract No. F08637-83-R0062. This report contains a summary and an evaluation of the information collected during Phase I of the IRP. The land areas included as part of the Sheppard AFB study are as follows:

Main Base	5,249 acres
Lake Texoma Annex (use permit)	350 acres
Frederick, OK Airport (joint use)	9 acres

The objective of the first phase of the program was to identify the potential for environmental contamination from past waste disposal practices at Sheppard AFB, and to assess the potential for contaminant migration. The activities that were performed in the Phase I study included the following:

- Review of site records
- Interviews with personnel familiar with past generation and disposal activities
- Survey of types and quantities of waste generated
- Determination of estimated quantities and locations of current and past hazardous waste treatment, storage, and disposal
- Definition of the environmental setting at the base
- Review of past disposal practices and methods

- Performance of field and aerial inspection
- Collection of pertinent information from federal, state, and local agencies
- Assessment of the potential for contaminant migration
- Development of recommendations for follow-on actions

ES performed the on-site portion of the records search during October, 1983. The following core team of professionals was involved:

- E. H. Snider, P.E., Chemical Engineer and Project Manager, Ph.D. Chemical Engineering, 7 years of professional experience.
- H. D. Harman, P.G., Hydrogeologist, B.S. Geology, 9 years of professional experience.
- M. I. Spiegel, Environmental Scientist, B.S. Environmental Science, 6 years of professional experience.

More detailed information on these individuals is presented in Appendix A.

METHODOLOGY

The methodology utilized in the Sheppard AFB Records Search began with a review of past and present industrial operations conducted at the base. Information was obtained from available records such as shop files and real property files, as well as interviews with 60 past and present base employees from the various operating areas. A listing of Air Force interviewees by position and years of service is presented in Appendix B.

Concurrent with the base interviews, the applicable federal, state and local agencies were contacted for pertinent base related environmental data. The agencies contacted and interviewed are listed below as well as in Appendix B.

- o U.S. Environmental Protection Agency (EPA)
- o U.S. Geological Survey (USGS), Water Resources Division
- o U.S. Department of Agriculture (USDA), Soil Conservation Service
- o U.S. Army Corps of Engineers, Geotechnical Branch

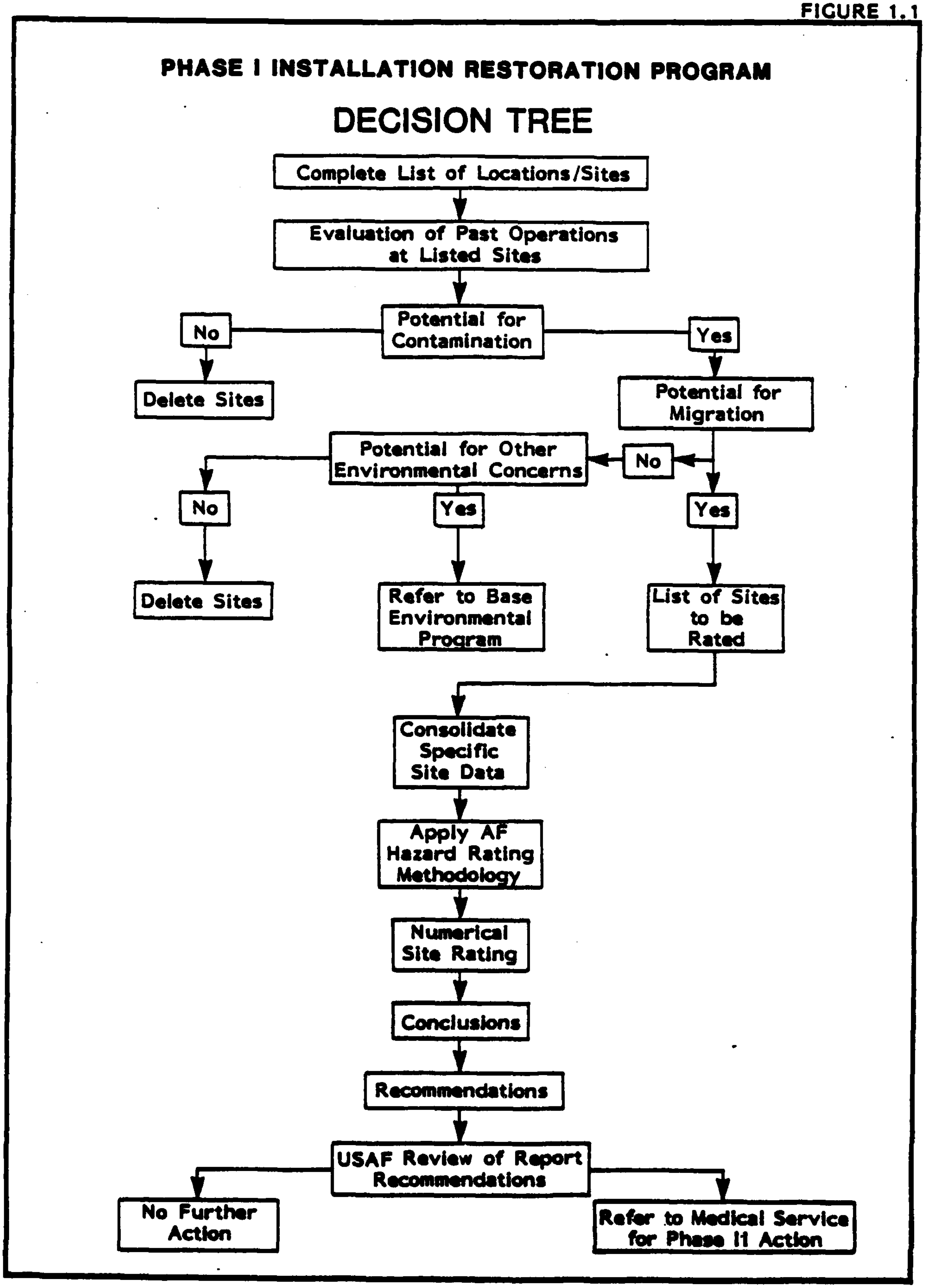
- National Oceanic and Atmospheric Administration (NOAA), National Climatic Data Center
- Texas Bureau of Economic Geology
- Texas Department of Health, Division of Solid Waste Management
- Texas Department of Water Resources
- Texas Parks and Wildlife Department
- Red River Authority of Texas
- Nortex Regional Planning Commission
- Petroleum Information Corporation
- City of Burkburnett, Water Department
- City of Wichita Falls, Planning
- City of Wichita Falls, Public Utilities
- Wichita County Water Improvement District No. 2
- Wichita Falls City - Wichita County Public Health Center

The next step in the activity review was to identify all sources of hazardous waste generation and to determine the past management practices regarding the use, storage, treatment, and disposal of hazardous materials from the various Air Force operations on the base. A master list of shops is listed in Appendix E. Included in this part of the activities review was the identification of all known past disposal sites and other possible sources of contamination such as spill areas.

A general ground tour and an airplane overflight of the identified sites were then made by the ES Project Team to gather site-specific information including: (1) general observations of existing site conditions; (2) visual evidence of environmental stress; (3) the presence of nearby drainage ditches or surface water bodies; and (4) visual inspection of these water bodies for any obvious signs of contamination or leachate migration.

A decision was then made, based on all of the above information, whether a potential exists for hazardous material contamination at any of the identified sites using the Decision Tree shown in Figure 1.1. If no potential existed, the site was deleted from further consideration. For those sites where a potential for contamination was identified, a determination of the potential for migration of the contamination was

FIGURE 1.1


PHASE I INSTALLATION RESTORATION PROGRAM
DECISION TREE
Complete List of Locations/Sites
Evaluation of Past Operations at Listed Sites
Potential for Contamination
No
Yes
Delete Sites
Potential for Migration
Potential for Other Environmental Concerns
No
No
Yes
Yes
Delete Sites
Refer to Base Environmental Program
List of Sites to be Rated
Consolidate Specific Site Data
Apply AF Hazard Rating Methodology
Numerical Site Rating
Conclusions
Recommendations
USAF Review of Report Recommendations
No Further Action
Refer to Medical Service for Phase II Action

made by considering site-specific conditions. If there were no further environmental concerns, then the site was deleted. If there are other environmental concerns, then these are referred to the base environmental program. If the potential for contaminant migration was considered significant, then the site was evaluated and prioritized using the Hazard Assessment Rating Methodology (HARM). A discussion of the HARM system is presented in Appendix G.

SECTION 2

INSTALLATION DESCRIPTION

LOCATION, SIZE, AND BOUNDARIES

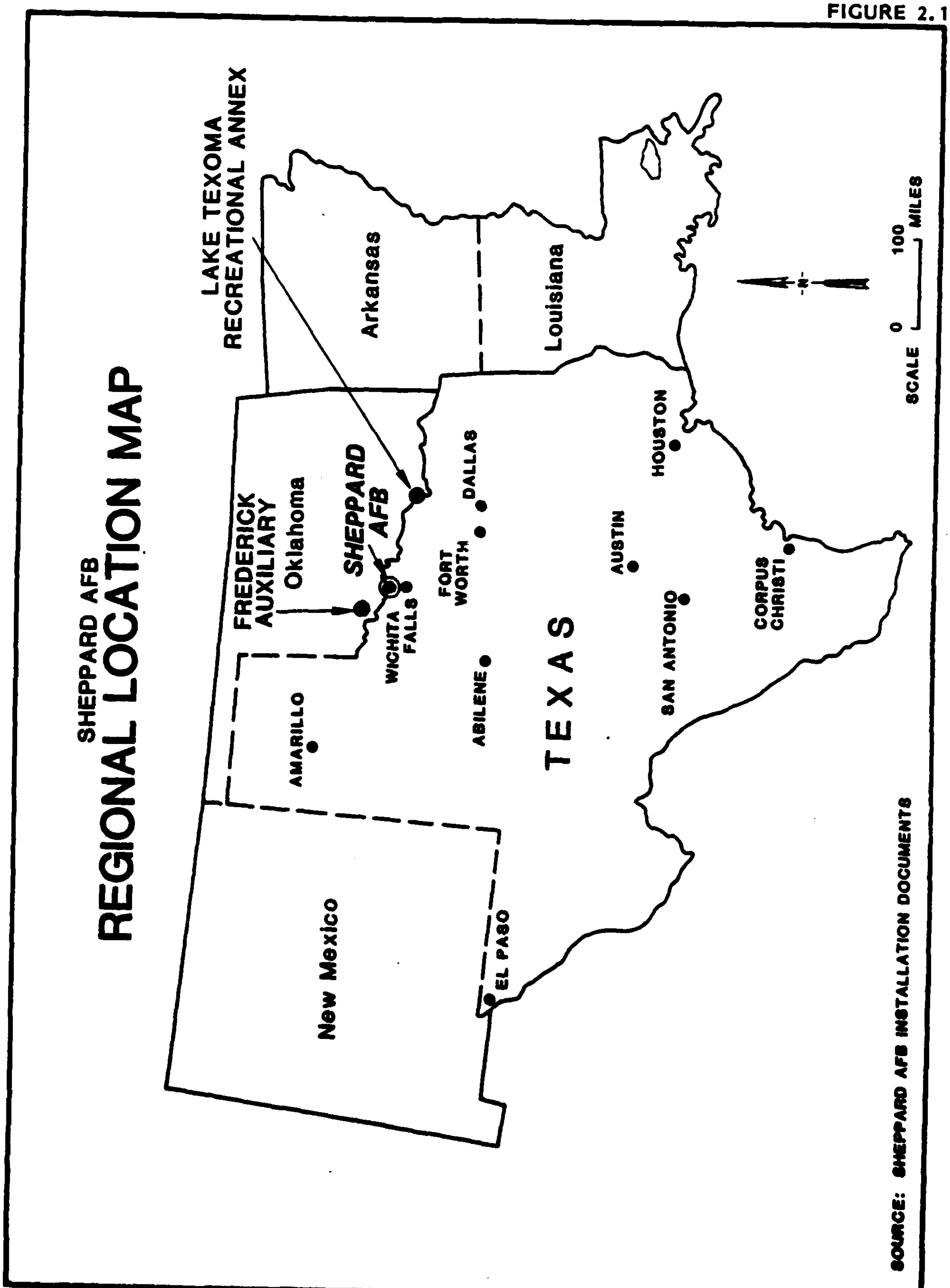
Sheppard Air Force Base is located four miles north of Wichita Falls, Texas, which is in the north-central portion of Texas and approximately 150 miles northwest of Dallas (see Figures 2.1 and 2.2). The base is bordered by agricultural lands on the north and east, a road with limited residential and commercial development on the south, and a major highway with commercial development on the west. Bear Creek flows through the northern section of the base property.

The base comprises 5,249 acres of U.S. government-owned land (see Figure 2.3). Two remote installation facilities exist as described below:

- Lake Texoma Recreational Annex - This site consists of 350 acres of land adjacent to Lake Texoma in Grayson County, Texas, about 120 miles east of the base. This site is operated by the Air Force under a use permit from the U.S. Army Corps of Engineers. The property includes 45 cabins, as well as camping and boating facilities, and is surrounded by Lake Texoma and lake-area woodlands. Water is obtained from a well, and sewage treatment is provided by a package treatment plant with discharge into Lake Texoma. The location of this site is shown in Figure 2.1 and the site orientation is shown in Figure 2.4.

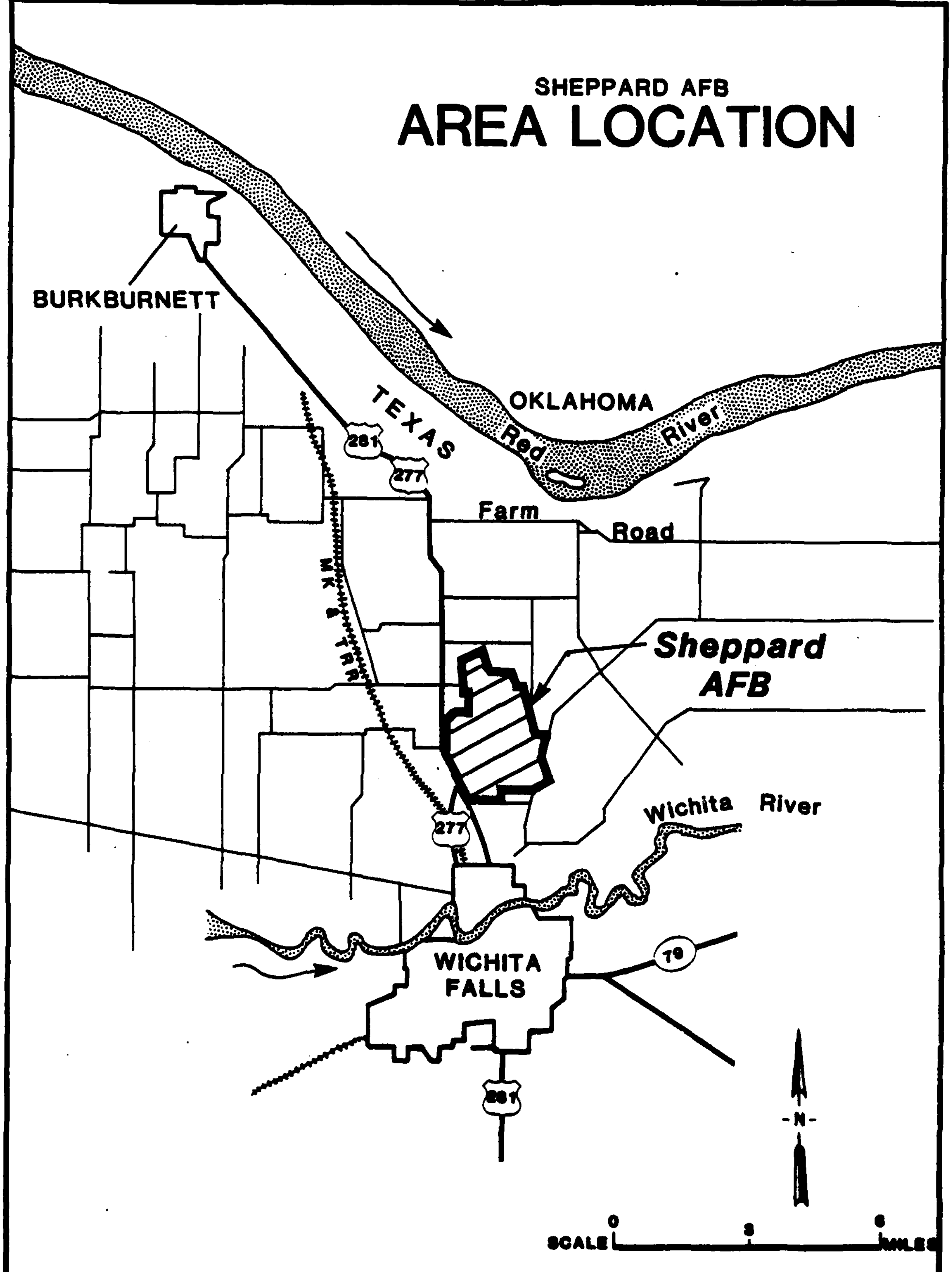
- Frederick, Oklahoma Municipal Airport - This site consists of nine acres of land under joint use by Sheppard AFB and the Frederick Municipal Airport. This site is about 80 miles north of Sheppard AFB, and is used as an auxiliary landing site for

FIGURE 2.1



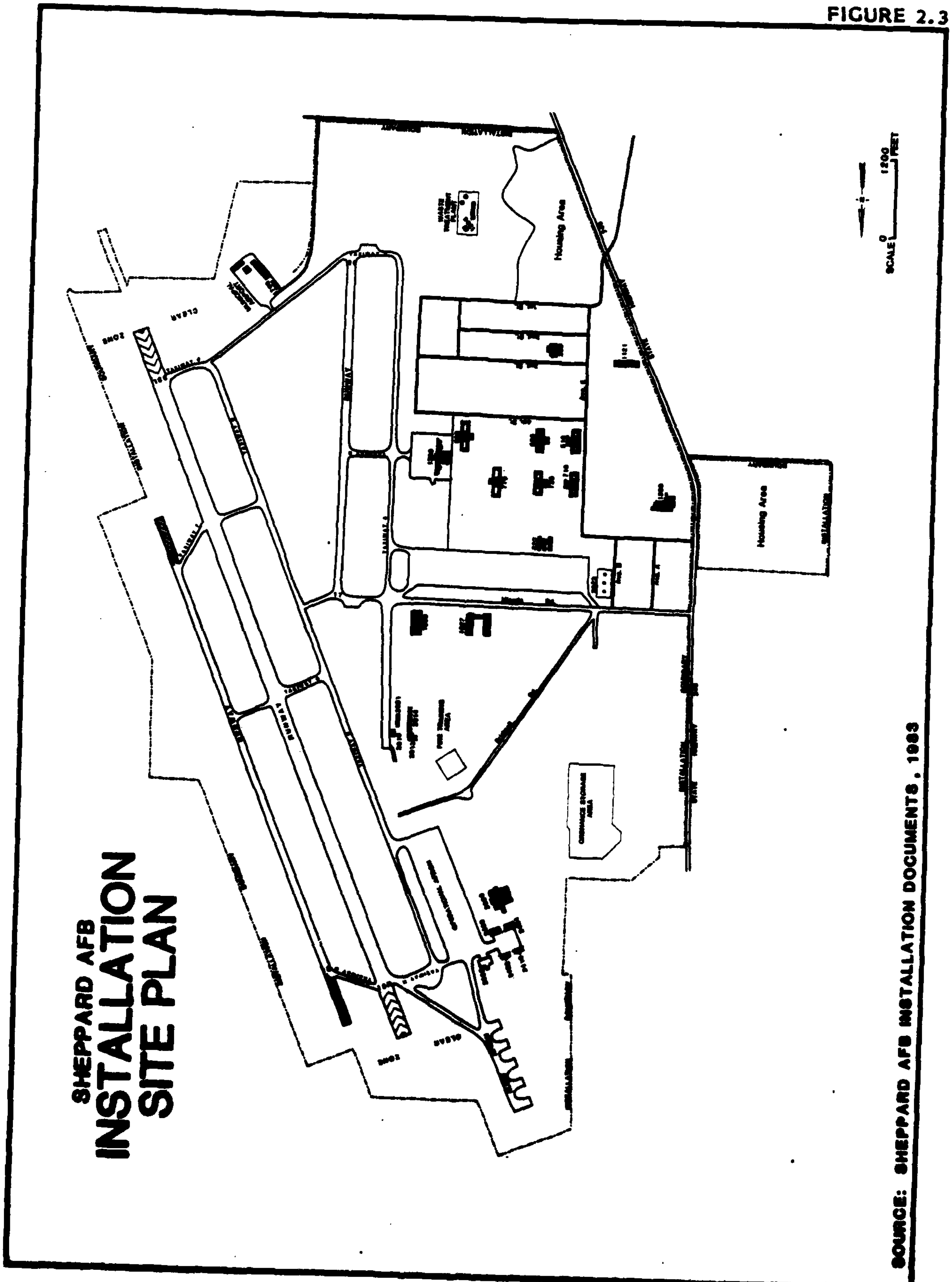
SHEPPARD AFB
REGIONAL LOCATION MAP

FIGURE 2.2



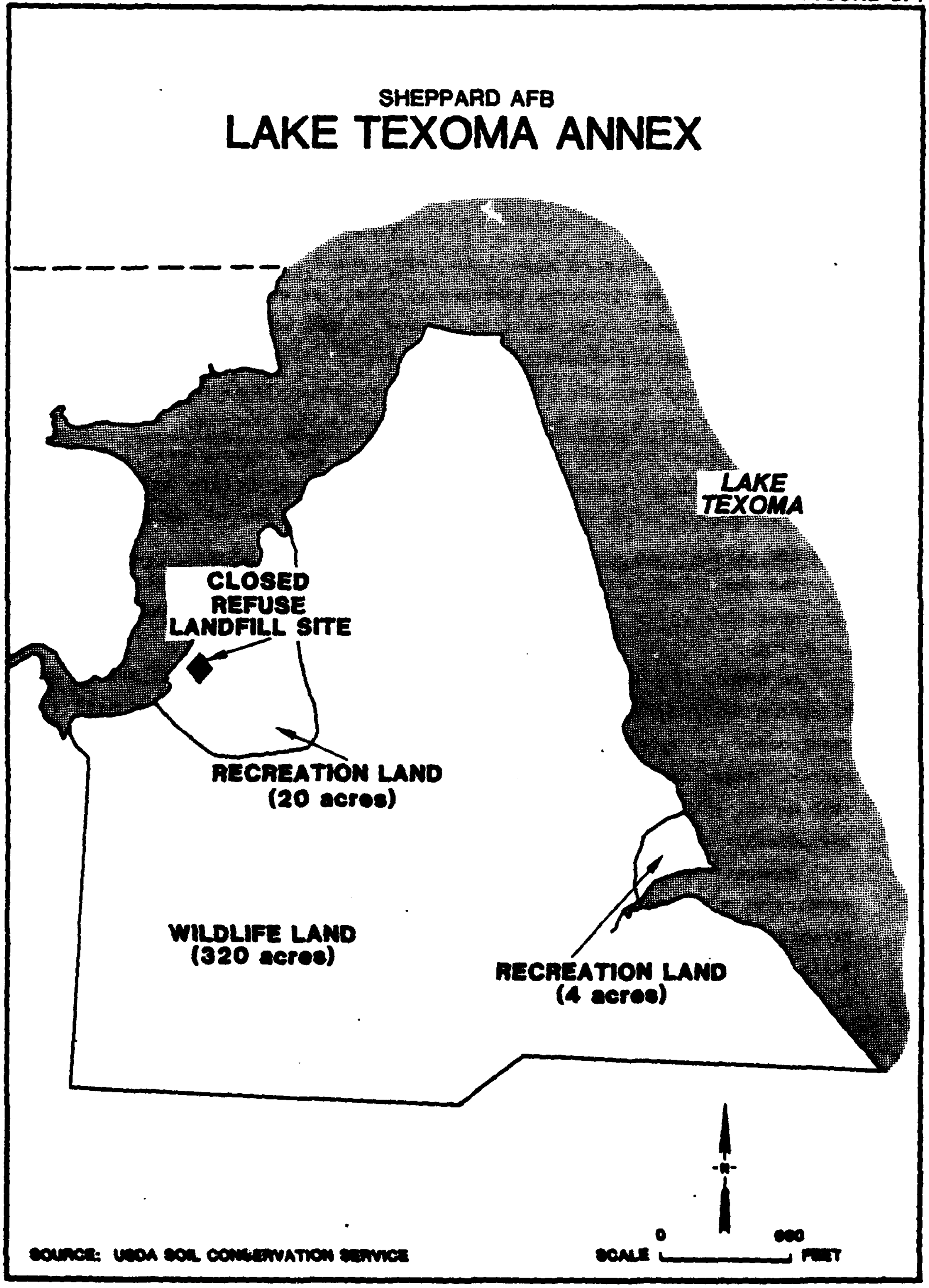
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

FIGURE 2.3



SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS, 1983

FIGURE 2.4



ENGINEERING-SCIENCE

T-37 aircraft. No maintenance facilities or other hazardous waste generators under the control of Sheppard AFB are present at this site. The location of this site is shown in Figure 2.1.

BASE HISTORY

Plans for a training school in north central Texas were first approved by the Army Air Corps February 13, 1941, after procurement of a 300 acre site in 1940. The first contingent of men arrived in June and Sheppard Field was activated October 17, 1941.

During World War II, basic training schools were conducted at Sheppard Field for glider mechanics, advanced pilot training, liaison aircraft training for ground officers, training for instructors, B-29 engineers, and C-82 transport mechanics, in addition to the aviation mechanics school. Sheppard reached its peak strength of 46,304 in November, 1945.

The field was deactivated August 31, 1946, and was manned by a caretaker staff. The base facilities were not used during the period of inactivity.

On August 15, 1948, the field was reactivated as Sheppard Air Force Base, and has maintained active status since that date. Sheppard was reactivated to supplement Lackland AFB, Texas, as a basic training center. Basic training was conducted until June, 1949, and again from 1950 until 1952, and Phase II of basic military training was conducted periodically from 1956 until 1966.

Numerous training schools have been transferred to Sheppard AFB. A summary of the progress of the base mission, especially as it concerns training schools which have the potential for hazardous waste generation, is contained in the following discussion.

In 1949, the Airplane and Engine Mechanics School was transferred to Sheppard from Keesler AFB. This school later became the Department of Aircraft Maintenance Training in the USAF School of Applied Aerospace Sciences (SAAS).

During the 1950's, several significant training schools became a part of Sheppard AFB. In 1954, Comptroller and Transportation Training were transferred from Lowry AFB to Sheppard. The Department of Missile and Space Training was established in 1956, and in 1958 Sheppard was

designated the prime training center for the Atlas, Titan, Thor, and Jupiter ballistic missiles. At present, Sheppard has prime responsibility for Titan II and related space system training. Communications training and Civil Engineering training were transferred to Sheppard in 1958-59. In January 1958, the 494th Bombardment Wing, Strategic Air Command (SAC), was activated at Sheppard as a tenant unit. This wing, composed of B-52 and KC-135 aircraft, remained at Sheppard until April, 1966, when it was transferred to Pease AFB. In 1959, Sheppard assumed a portion of Field Training from Chanute AFB.

During the 1960's, significant changes at Sheppard included the activation of the 3637th Flying Training Squadron (Helicopter) in 1965 and the transfer of the Medical Services School from Gunter AFB in 1966. The 3637th Flying Training Squadron became part of what is now the 80th Flying Training Wing (FTW), which presently conducts training in T-37 and T-38 aircraft. The Medical Service School, presently the School of Health Care Sciences (SHCS), conducts orientation of newly commissioned officers and advanced professional medical training.

ORGANIZATION AND MISSION

The host unit at Sheppard Air Force Base is HQ Sheppard Technical Training Center (STTC). There are three major units in STTC; the 3700th Technical Training Wing (TCHTW), the School of Health Care Sciences USAF (SHCS), and the 3785th Field Training Group (FLDTG). The 3700th TCHTW serves as the instruction unit for aircraft maintenance, communications, civil engineering, missile systems, comptroller functions, and transportation skills. The SHCS instructs officers and airmen in medical specialties and related sciences and furnishes military orientation for newly commissioned medical officers. The 3785th FLDTG supplies system- or job-oriented maintenance training and associate courses, and provides familiarization training to acquaint aircrew members with specific aircraft systems.

Staff, support, and tenant agencies are also present at Sheppard. Staff agencies include the Staff Judge Advocate, the Public Affairs Office, the Social Actions Office, the Standardization and Evaluation Division, the Programs Division, the Safety Office, and the Historian's Office. Support units are comprised of the 3750th Air Base Group (ABG),

Deputy Commander for Resource Management, and the USAF Regional Hospital.

The major tenant organizations at Sheppard Air Force Base are listed below. Descriptions of the major tenant organizations and their missions are presented in Appendix C.

80th Flying Training Wing (FTW)
Air Force Audit Agency Office
2054th Communications Squadron
3314th Management Engineering Squadron, Detachment 5
24th Weather Squadron, Detachment 12
Federal Aviation Administration (FAA) Representative
Headquarters Commissary

SECTION 3

ENVIRONMENTAL SETTING

The environmental setting of Sheppard Air Force Base is described in this chapter with an emphasis on the identification of natural features that may promote the movement of hazardous waste contaminants. Environmental conditions pertinent to this study are summarized at the conclusion of this chapter.

METEOROLOGY

The climate of the Wichita Falls area is characterized by rapid temperature changes and erratic rainfall. During winters, with the passage of cold fronts from the north temperatures may drop as much as 20°F to 30°F within several hours . Rainfall normally occurs between March and November but during this time dry periods lasting three to four weeks are common. The continental climate, typical of Wichita Falls, has mild winters and low humidity summers. Good wind movement, visibility, and high aviation ceiling make Wichita Falls and Sheppard AFB excellent areas for aviation exercises (National Oceanic and Atmospheric Administration (NOAA), 1983). Selected meteorological data for Sheppard AFB are summarized in Table 3.1.

Two climatic features of interest in determining the potential for movement of contaminants are net precipitation and rainfall intensity. Net precipitation is an indicator of the potential for leachate generation and is equal to the difference between precipitation and evaporation. Rainfall intensity is an indicator of the potential for excessive runoff and erosion. The one-year, 24-hour rainfall event is used to gauge the potential for runoff and erosion. Net precipitation at Sheppard AFB is minus (-)36.92 inches as determined from meteorological data. The mean annual precipitation at the base for the period 1948-1982 is 27.08 inches (Sheppard AFB Documents) and the mean annual lake evaporation for the area is 64 inches (NOAA, 1979). The negative value

TABLE 3.1
CLIMATIC DATA FOR SHEPPARD AFB

	JAN	FEB	MAR	APR	MAY	JUNE	JULY	AUG	SEP	OCT	NOV	DEC
TEMPERATURE (°F)												
Mean Daily Maximum	52	58	66	77	84	93	98	97	88	78	64	56
PRECIPITATION (IN)												
Mean	0.97	1.12	1.73	3.01	4.55	2.93	2.20	2.15	3.32	2.46	1.38	1.26
SNOWFALL (IN)												
Mean	1.9	2.0	0.9	T	0	0	0	0	0	T	0.4	0.9

Period of Record: 1948-1982 T = Trace

Source: Detachment 12, 24th Weather Squadron

of net precipitation indicates that there is little or no potential for precipitation to infiltrate the surface soils on the base. The one-year, 24-hour rainfall event in the area of the base is estimated to be 2.8 inches (NOAA, 1963). This value indicates that there is a moderate potential for runoff and erosion.

GEOGRAPHY

Sheppard AFB is located within the Central Rolling Red Plains Physiographic Province of north central Texas (Figure 3.1). This province is characterized by rolling topography although large flat areas are present (USDA, 1977). The native soils and bedrock in the province contain iron which is red in color. Hence, the word "Red" in the province name.

Topography

The topography of Sheppard AFB is typical of the general province topography. The base covers land with broad rolling hills as well as large flat areas. The highest hill on the base is south of the regional hospital (Building 1200) and rises to an approximate elevation of 1,075 feet above the National Geodetic Vertical Datum of 1929 (NGVD). A second, but less prominent hill (1,025 feet NGVD) is located on the base golf course. The runway area as well as the area in the northeastern portion of the base are relatively flat with elevations ranging from 990 to 1,015 feet NGVD. These areas are dissected by several streams which have almost vertical-cut banks. For example, the stream adjacent to Landfill No. 3 has cut vertically three to five feet into the land surface. In the northwestern portion of the base, just west of Building 2320, a relatively large depression exists as a storm ponding area for Bear Creek and its tributaries after they enter the base.

The areas immediately surrounding Sheppard AFB include agricultural lands to the southeast, east, north and northwest, residential areas (base housing) to the west and commercial areas to the southwest and south.

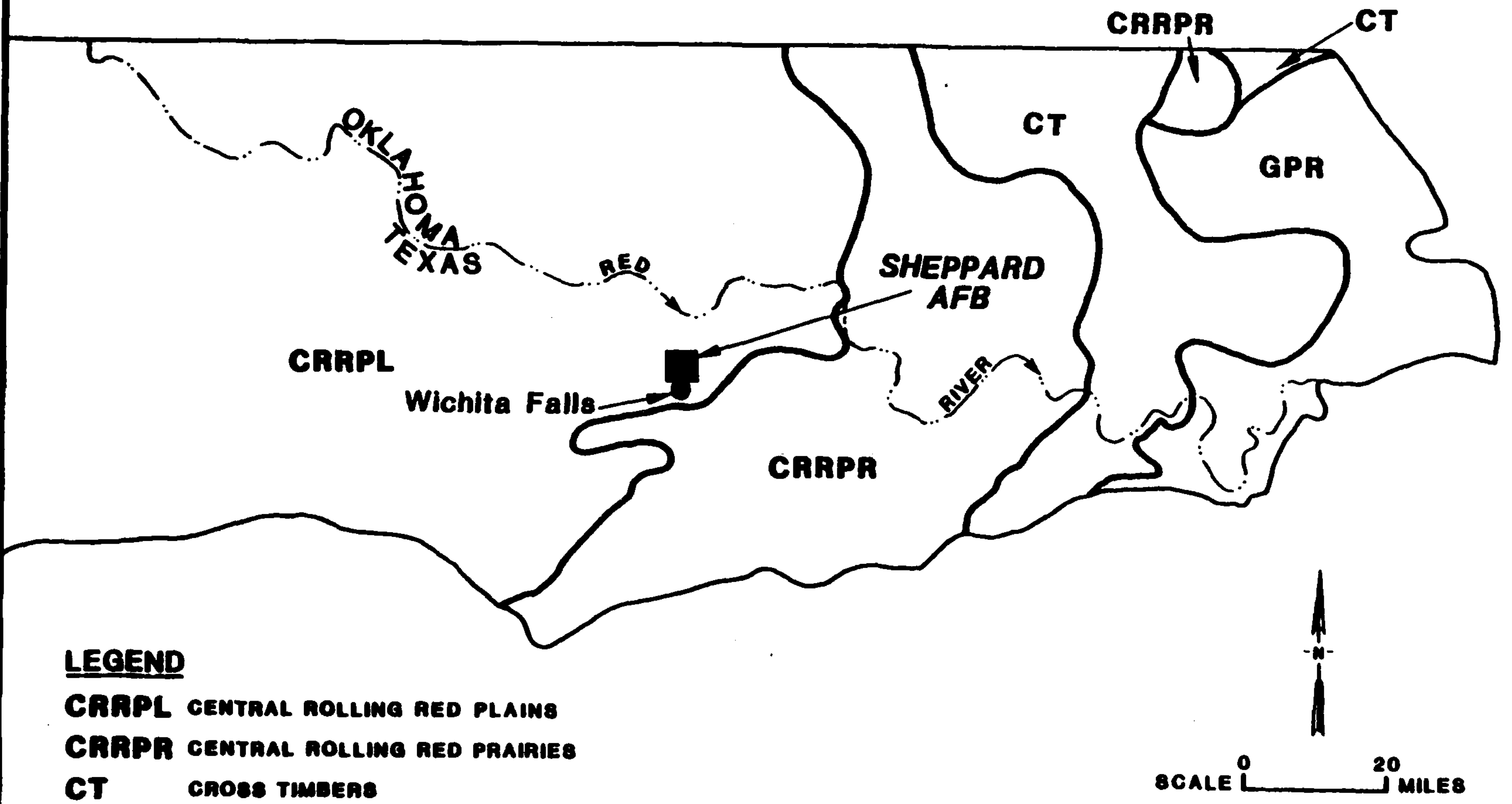
Soils

The soils of Sheppard AFB are typically loam and combinations of sandy, silty, and clayey loam. Loam is a soil with varying proportions of sand, clay, and organic matter. Some soils have developed on land

FIGURE 3.1

SHEPPARD AFB

REGIONAL PHYSIOGRAPHIC FEATURES



LEGEND

CRRPL CENTRAL ROLLING RED PLAINS
CRRPR CENTRAL ROLLING RED PRAIRIES
CT CROSS TIMBERS
GPR GRAND PRAIRIE

SOURCE: USDA, 1977

which has been flooded in some parts of the base and on land which has been affected by wind erosion and sedimentation in other parts of the base. Asa and Port soils are frequently flooded while Oben fine sandy loam soils show signs of wind erosion and contain fine sand. Figure 3.2 is the Sheppard AFB soils map. The soil symbol as shown on the map corresponds to the soil descriptions and engineering properties as summarized in Table 3.2.

The soil property of concern in assessing the potential for surface-water infiltration is vertical permeability. The vertical permeability values for the soils on the base range from less than 4.2×10^{-5} centimeters per second (cm/sec) to 1.4×10^{-3} cm/sec (Richardson, et al., 1977). These values indicate that surface water will infiltrate with a moderate to slow rate. The Soil Conservation Service (SCS) has ranked the soils on the base as having severe use limitations for septic tank absorption fields. The SCS has noted shallow depth to rock and slow percolation as reasons for the severe use limitations.

SURFACE-WATER RESOURCES

Sheppard AFB is located in the Red River Drainage Basin of north-central Texas. The Red River is the state boundary of Texas and Oklahoma approximately five miles north of the base. Within the Red River Drainage Basin the base is located in the drainage area of the Wichita River. The Wichita River located between the base and the City of Wichita Falls flows in a northeasterly direction towards the Red River. Within the Wichita River Drainage Basin a system of lakes, canals, and lateral canals regulates surface-water flow from lakes and small streams to the Wichita River (Banks, 1983).

Drainage

Drainage on Sheppard AFB is controlled by open ditches, concrete-lined ditches, and underground storm drainage mains (Figure 3.3). Drainage from areas north of Missile Road generally flows north, east, and southeast while drainage from areas south of Missile Road generally flows south and southeast. Drainage north of Missile Road is joined by discharge from a wastewater treatment plant owned by Wichita Falls and flow from Bear Creek as it enters the base. An intermittent stream also enters the northwestern portion of the base approximately 2,500 feet

TABLE 3.2
SHEPPARD AIR FORCE BASE SOILS

Symbol on Figure 3.2	Unit Description	Depth (inches)	Permeability (centimeters/second)	Septic Tank Absorption Field Use Limitation
Aw	Asa and Port soils, frequently flooded, silty clay loam	0-18	4.2×10^{-4} - 1.4×10^{-3}	[1]Severe; floods
		18-60	4.2×10^{-4} - 1.4×10^{-3}	
BeB	Bluegrove loam, 1 to 3 percent slopes	0-8	4.2×10^{-4} - 1.4×10^{-3}	Severe; depth to rock; percolation slow.
		8-34	1.4×10^{-4} - 4.2×10^{-4}	
		34-64	(no value; weakly cemented sandstone)	
BuB	Bluegrove - Urban land complex, 1 to 3 percent slopes	0-8	4.2×10^{-4} - 1.4×10^{-3}	Severe; depth to rock; percolation slow.
		8-34	1.4×10^{-4} - 4.2×10^{-4}	
		34-64	(no value; weakly cemented sandstone)	
DaA	Deandale silt loam, 0 to 1 percent slopes	0-12	4.2×10^{-4} - 1.4×10^{-3}	Severe; percolation slow.
		12-90	$< 4.2 \times 10^{-4}$	
DaB	Deandale silt loam, 1 to 3 percent slopes	0-12	4.2×10^{-4} - 1.4×10^{-3}	Severe; percolation slow.
		12-90	$< 4.2 \times 10^{-4}$	
DbA	Deandale silt loam, loamy substratum, 0 to 1 percent slopes	0-8	4.2×10^{-4} - 1.4×10^{-3}	Severe; percolation slow.
		8-74	$< 4.2 \times 10^{-5}$	
		74-86	1.4×10^{-4} - 4.2×10^{-4}	
		86-100	4.2×10^{-4} - 1.4×10^{-3}	

Notes: [1] Severe means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

W = Signs of wind erosion are present.
Source: Richardson, et al., 1977

TABLE 3.2

SHEPPARD AIR FORCE BASE SOILS
(Continued)

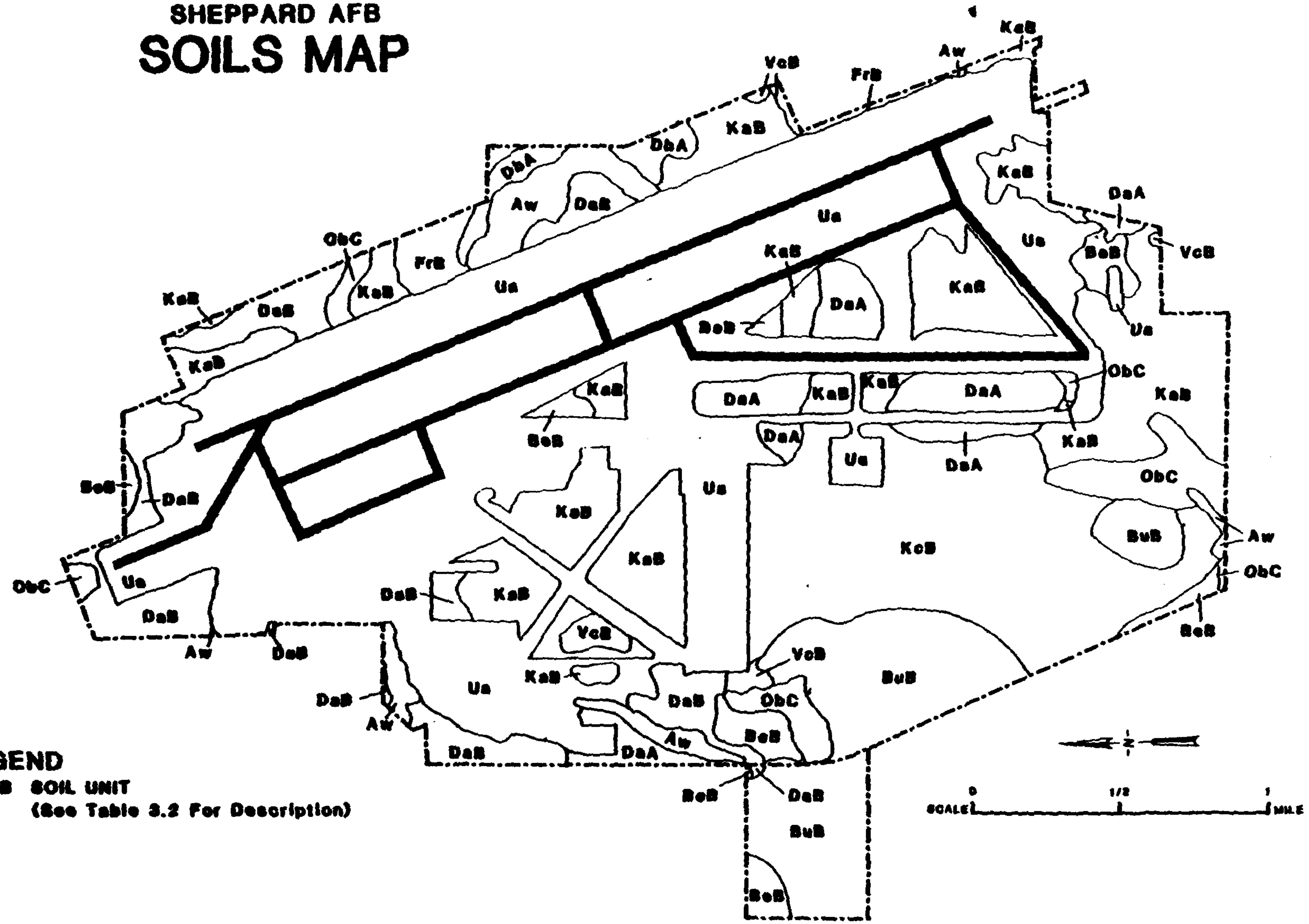
Symbol on Figure 3.2	Unit Description	Depth (inches)	Permeability (centimeters/second)	Septic Tank Absorption Field Use Limitation
FrB	Frankirk loam, 1 to 3 percent slopes	0-7	$4.2 \times 10^{-4} - 1.4 \times 10^{-3}$	Severe; percolation slow.
		7-55	$1.4 \times 10^{-4} - 4.2 \times 10^{-4}$	
KaB	Kamay silt loam, 1 to 3 percent slope	0-10	$4.2 \times 10^{-4} - 1.4 \times 10^{-3}$	Severe; percolation slow.
		10-100	$< 4.2 \times 10^{-5}$	
KcB	Kamay - Urban land complex, 0 to 3 percent slopes	0-10	$4.2 \times 10^{-4} - 1.4 \times 10^{-3}$	Severe; percolation slow.
		10-100	$< 4.2 \times 10^{-5}$	
ObC	Oben fine sandy loam, 1 to 5 percent slopes (W)	0-6	$4.2 \times 10^{-4} - 1.4 \times 10^{-3}$	Severe; depth to rock.
		6-17	$4.2 \times 10^{-4} - 1.4 \times 10^{-3}$	
		17-36	(no value; weakly cemented sandstone)	
Ua	Urban land	(Too variable to be rated)		
VcB	Vernon clay loam, 1 to 3 percent slopes	0-7	$1.4 \times 10^{-4} - 4.2 \times 10^{-4}$	Severe; percolation slow.
		7-34	$< 4.2 \times 10^{-5}$	
		34-60	$< 4.2 \times 10^{-5}$	

Notes: [1] Severe means that soil properties are so unfavorable and so difficult to correct or overcome that major soil reclamation, special design, or intensive maintenance is required.

W = Signs of wind erosion are present.
Source: Richardson, et al., 1977

FIGURE 3.2

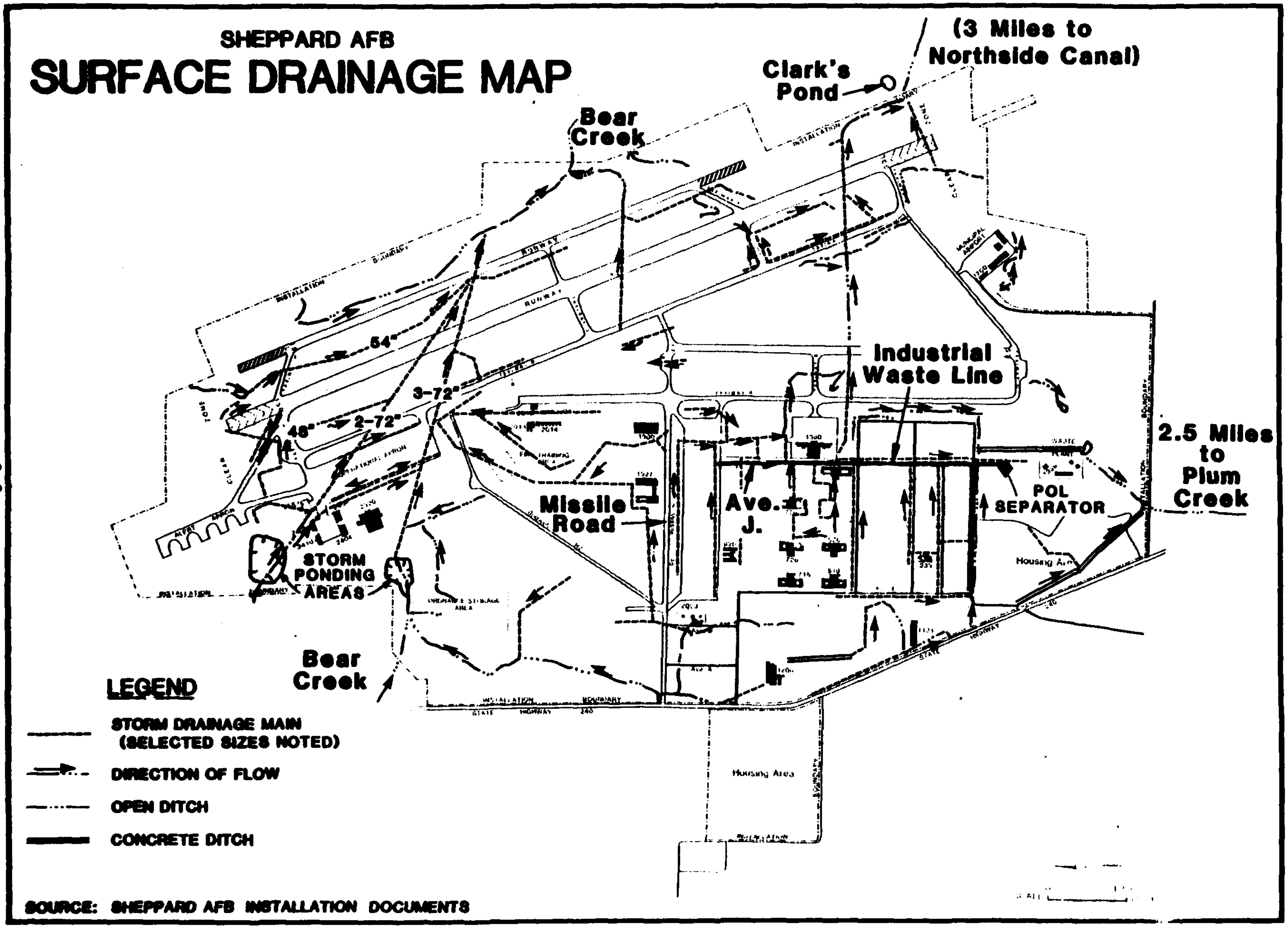
SHEPPARD AFB
SOILS MAP



LEGEND

BeB SOIL UNIT
(See Table 3.2 For Description)

SOURCE: RICHARDSON, et al., 1977


SHEPPARD AFB
SURFACE DRAINAGE MAP
Bear Creek
Clark's Pond
(3 Miles to Northside Canal)
54"
3-72"
48"
2-72"
Industrial Waste Line
Missile Road
Ave. J.
POL SEPARATOR
2.5 Miles to Plum Creek
STORM PONDING AREAS
Bear Creek
Housing Area
LEGEND
STORM DRAINAGE MAIN (SELECTED SIZES NOTED)
DIRECTION OF FLOW
OPEN DITCH
CONCRETE DITCH
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

northeast of the Bear Creek entrance. Two additional intermittent streams enter the northeastern portion of the base. Three of the four northern streams flow through underground concrete pipes ranging in diameter from 48 inches to 72 inches.

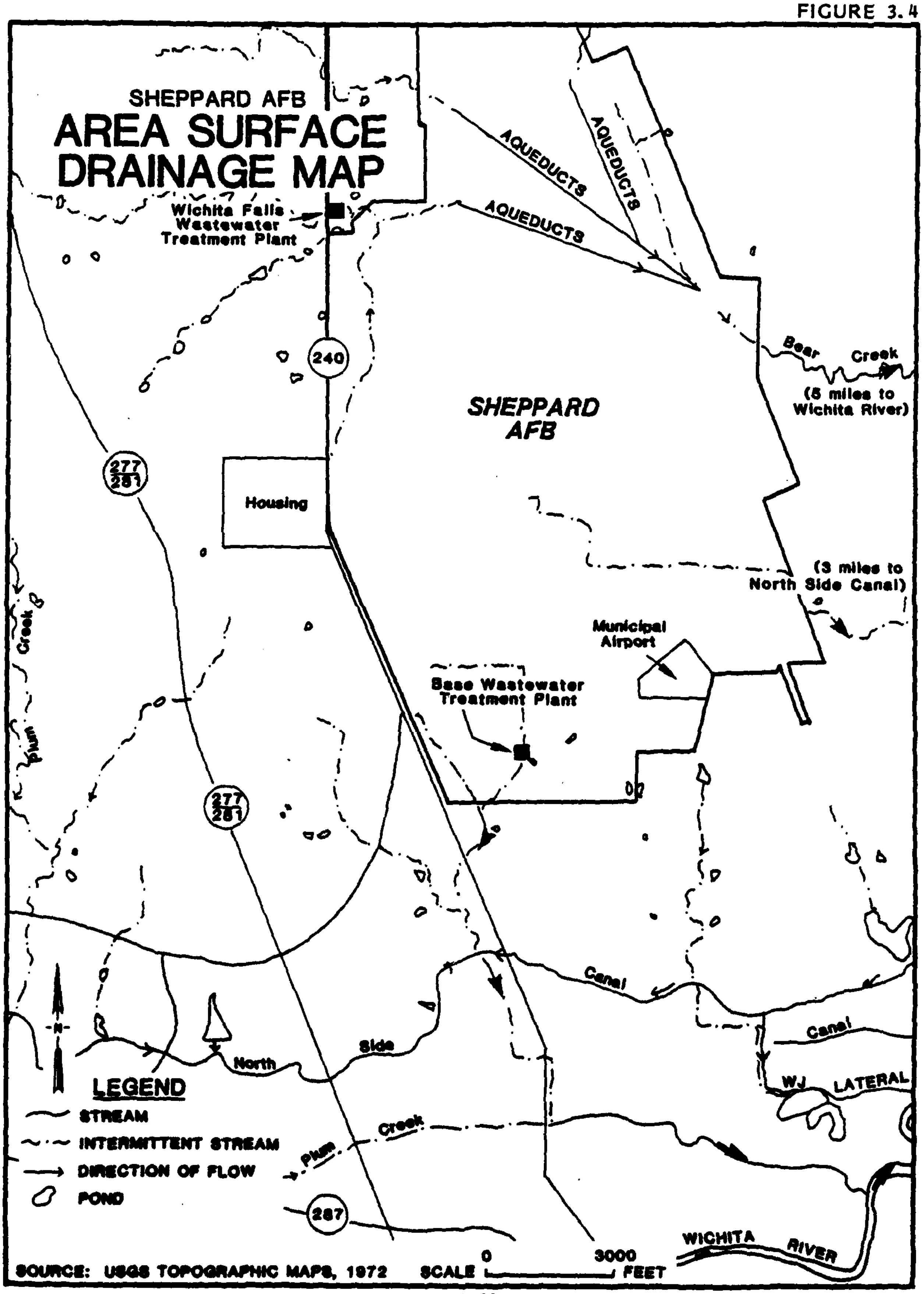
Significant drainage features in the northern portion of the base are the storm ponding areas. One is located west of Building 2320 and the other is located southwest of the Alert Apron. Bear Creek flows through the former area prior to entering three 72-inch diameter underground pipes. Erosion is moderately developed in the area along frequent paths of storm drainage. Vegetation (grasses and primary tree growth) is abundant in the areas.

Drainage south of Missile Road flows south toward a tributary of Plum Creek and southeast toward a tributary of North Side Canal. Drainage from the southwest portion of the base generally flows south and is joined by discharge from the base wastewater treatment plant. Drainage from the southeast portion of the base generally flows southeast toward Clark's Pond just off base, but the major flow of the stream does not actually flow into Clark's Pond. Localized drainage also flows into small ponds on the golf course.

A significant drainage feature in the southern portion of the base is the industrial waste line located along Avenue J. As shown in Figure 3.3, the industrial waste line is a discharge line for waste oil and fuel.

Surface-water drainage off base enters three area-wide drainage features. These features are Bear Creek, North Side Canal, and Plum Creek (Figure 3.4). Base drainage through the underground pipes or aqueducts in the northern portion of the base enters Bear Creek and flows approximately five miles to the Wichita River. Base drainage in the southeastern portion of the base enters a tributary of North Side Canal which is approximately three miles southeast of the base. Depending on the gravity flow system, North Side Canal empties into either Bear Creek to the northeast or a tributary of Plum Creek to the southwest. Base drainage in the southwestern portion of the base along with discharges from the base wastewater treatment plant enters a tributary of Plum Creek. The tributary enters Plum Creek approximately 2.5 miles south of the base. Approximately five miles from the base, Plum Creek enters the Wichita River.

FIGURE 3.4


SHEPPARD AFB
AREA SURFACE DRAINAGE MAP
Wichita Falls Wastewater Treatment Plant
AQUEDUCTS
AQUEDUCTS
AQUEDUCTS
240
SHEPPARD AFB
Bear Creek
(5 miles to Wichita River)
277
281
Housing
(3 miles to North Side Canal)
Municipal Airport
Base Wastewater Treatment Plant
Plum Creek
Canal
Canal
North Side
WJ LATERAL
N
LEGEND
STREAM
INTERMITTENT STREAM
DIRECTION OF FLOW
POND
Plum Creek
287
WICHITA RIVER
SOURCE: USGS TOPOGRAPHIC MAPS, 1972
SCALE 0 3000 FEET

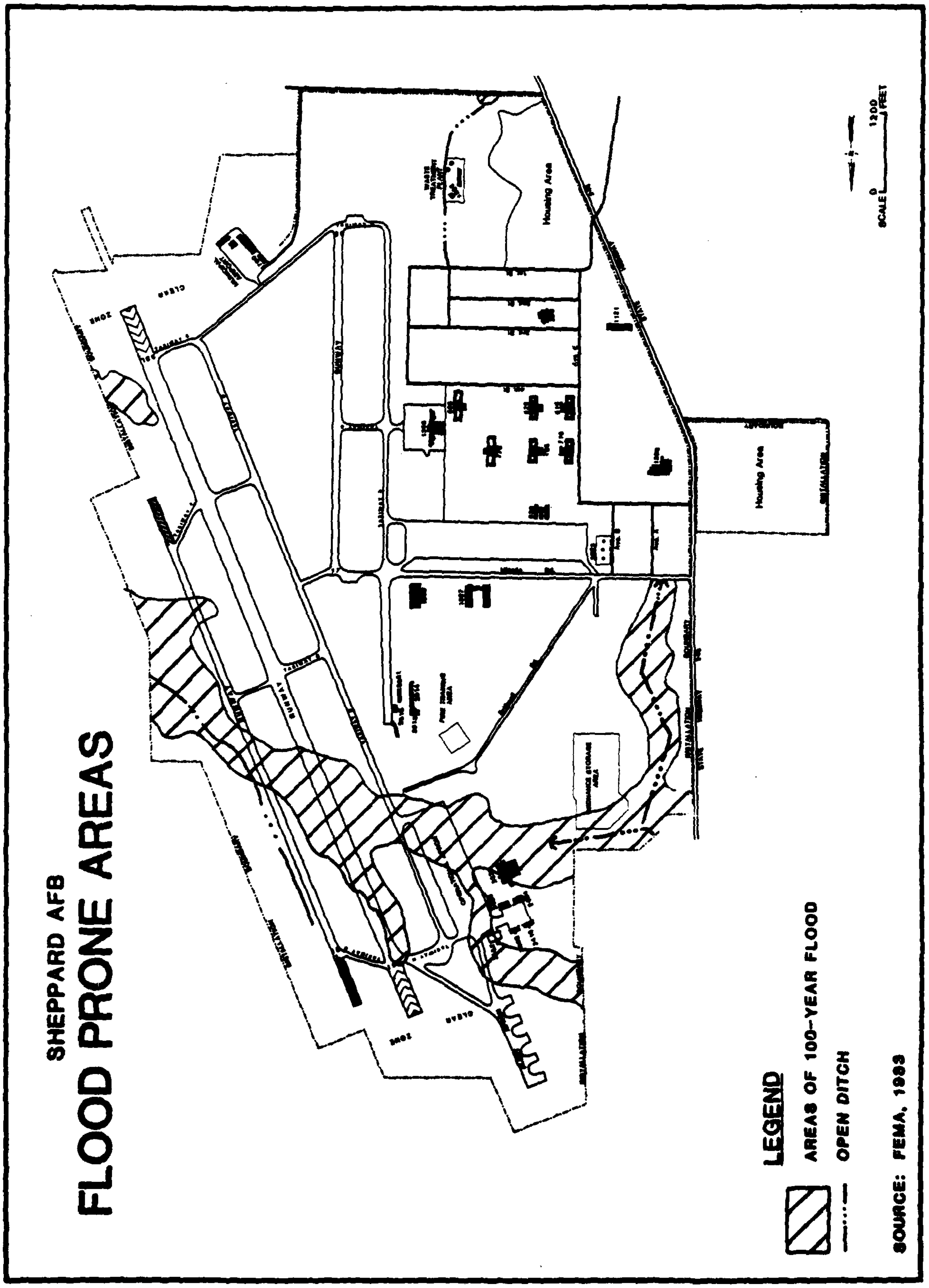
The surface-water streams on the base and in the vicinity of the base are affected by flood conditions. Figure 3.5 shows the extent of the 100-year flood event on the base. Flooding during a 100-year rain would be limited to the northeastern, northern, and northwestern portions of the base. A very small area south of the base wastewater treatment plant is subject to flooding. Recent flood events on the Wichita River during 1982 and 1983 in the Wichita Falls area were classified as a 2-year flood and a 10-year flood, respectively (Tidwell, 1984). These flood events did not adversely impact Sheppard AFB.

Surface-Water Quality

The surface-water quality of the Wichita River south of Sheppard AFB has been described as "water-quality limited" (Texas Department of Water Resources (TDWR, 1982). Dissolved oxygen, chloride, and sulfate problems have been identified. Potential problems are elevated levels of fecal coliform and nutrients (Red River Authority of Texas, 1982). A Wichita River Urban Runoff Program is scheduled for completion in July 1984. This program, initiated by the Red River Authority of Texas and the City of Wichita Falls, will include surface-water sampling on Plum Creek, the Wichita River, and Holliday Creek. The sampling point on Plum Creek may be of interest to Sheppard AFB.

Surface-water sampling on the base is conducted at four locations. These locations are Plum Creek, Clark's Pond, Bear Creek Entrance, and Bear Creek Exit (Figure 3.6). These four locations are sampled quarterly (March, June, September, and December) for selected organic and inorganic parameters. The results of the March 1982 analyses are shown in Table 3.3 and additional analyses are shown in Appendix D. The only parameters which exceeded drinking water standards during the sampling period from March 1981 to June 1983 were the pesticide heptachlor epoxide and the metal silver. The pesticide and metal were detected at the Plum Creek sampling location. The concentrations of the pesticide and metal were greater than the drinking water quality standards but this occurrence is only one out of ten sampling periods. The comparison of the concentrations to drinking water quality standards is made because local farmers downstream of the base may use shallow wells adjacent to surface-water ponds as domestic water supplies. Although there is general knowledge of wells in the area there are no records of the wells

FIGURE 3.5



SHEPPARD AFB
FLOOD PRONE AREAS
Housing Area
Housing Area
SCALE 0 1200 FEET
LEGEND
AREAS OF 100-YEAR FLOOD
OPEN DITCH
SOURCE: FEMA, 1983

TABLE 3.3
SELECTED SURFACE-WATER QUALITY DATA
FOR SHEPPARD AFB
(Parameter analyses are presented in milligrams per liter)

Parameter	Water-Quality Standard		Station Identification (Date Sampled; month-day-year)			
	AFR 161-44 (Drinking Water)	Texas Water Resources Dept. (Inland Waters)	Plum Creek (3-26-82)	Clark's Pond (3-24-82)	Bear Creek (Entrance to Base) (3-24-82)	Bear Creek (Exit from Base) (3-24-82)
Chemical Oxygen Demand	NS	NS	70	40	50	60
Total Organic Carbon	NS	NS	25	9	19	21
Oil and Greases	NS	NS	<5	<5	<5	<5
Cyanide	NS	NS	<.01	<.01	<.01	<.01
Phenols	NS	NS	<0.010	<0.010	<0.030	<0.030
Cadmium	0.01	0.05	NA	NA	NA	NA
Chromium	0.05	0.5	<0.050	<0.050	<0.050	<0.050
Chromium, Hexavalent	NS	NS	<0.050	<0.050	<0.050	<0.050
Copper	NS	0.5	<0.050	<0.050	<0.050	<0.050
Iron	NS	NS	0.120	0.440	1.2	0.710
Lead	0.05	0.5	<0.020	<0.020	<0.020	<0.020
Manganese	NS	1.0	<0.050	0.110	1.000	0.420
Mercury	0.002	0.005	<0.002	<0.002	<0.002	<0.002
Nickel	NS	1.0	<0.1	<0.1	<0.1	<0.1
Silver	0.05	0.05	<0.03	<0.03	<0.09	<0.07
Zinc	NS	1.0	<0.050	<0.050	<0.050	<0.050
Gold	NS	NS	NA	NA	NA	NA

Note: See Figure 3.6 for station locations.
Source: Sheppard AFB Documents and Texas Surface Water Quality Standards, 1981 and 1982.

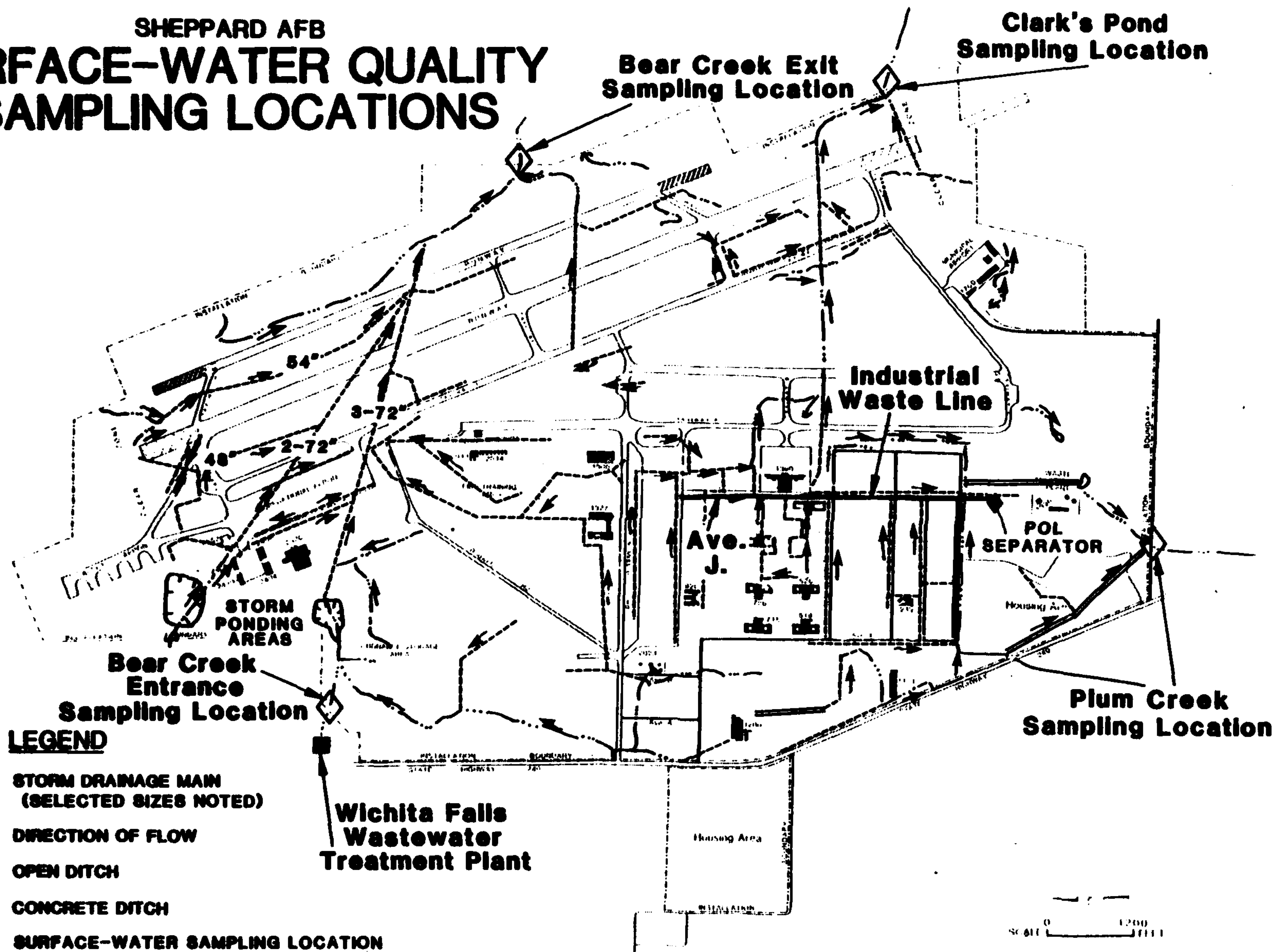
TABLE 3.3
WORST-CASE SURFACE-WATER QUALITY DATA
FOR SHEPPARD AFB (1981-82)
(Parameter analyses are presented in milligrams per liter)
(Continued)

Parameter	Water-Quality Standard		Station Identification (Date Sampled; month-day-year)			
	AFR 161-44 (Drinking Water)	Texas Water Resources Dept. (Inland Waters)	Plum Creek (3-26-82)	Clark's Pond (3-24-82)	Bear Creek (Entrance to Base) (3-24-82)	Bear Creek (Exit from Base) (3-24-82)
Chloride	NS	1,800	130	NA	NA	NA
Fluoride	1.6	NS	NA	NA	NA	NA
Surfactants	NS	NS	<0.5	<0.5	<0.5	<0.5
Aldrin	0.001	NS	<0.0002	<0.0001	<0.00002	<0.00002
Chlordane	0.003	NS	<0.0002	<0.001	<0.0002	<0.0002
DDT Isomers	0.05	NS	NA	<0.0005	<0.00002	<0.0001
Dieldrin	0.001	NS	<0.0002	<0.001	<0.00002	<0.00002
Endrin	0.0002	NS	NA	NA	NA	NA
Heptachlor	0.0001	NS	<0.0002	<0.0001	<0.00002	<0.00002
Heptachlor Epoxide	0.0001	NS	0.00036	0.0001	<0.00002	<0.00002
Lindane	0.004	NS	<0.0001	<0.00005	<0.00001	<0.00001
Methoxychlor	0.1	NS	NA	<0.0005	<0.0001	<0.0001
Toxaphene	0.005	NS	<0.010	<0.005	<0.001	<0.001
2,4-D	0.1	NS	0.00064	0.00003	<0.00003	<0.00004
2,4-5 TP Silvex	0.01	NS	NA	NA	NA	NA

Note: See Figure 3.6 for station locations.
Source: Sheppard AFB Documents and Texas Surface Water Quality Standards, 1981 and 1982.

FIGURE 3.6

SHEPPARD AFB
SURFACE-WATER QUALITY SAMPLING LOCATIONS



LEGEND

- STORM DRAINAGE MAIN (SELECTED SIZES NOTED)
- DIRECTION OF FLOW
- OPEN DITCH
- CONCRETE DITCH
- ◇ SURFACE-WATER SAMPLING LOCATION

SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

NOTE: SEE TABLE 3.3 FOR SELECTED WATER-QUALITY DATA

(Threadgill, 1984). Contaminants in the surface water may migrate to the shallow wells which derive their water from infiltration of adjacent surface water. The comparison of the concentrations to inland water quality standards indicates that only the silver concentration has exceeded those standards.

Wastewater treatment plant effluent sampling on a daily basis is conducted at the Plum Creek sampling location in accordance with Texas Permit No. 12511-01. Analyses for pH, total suspended solids, residual chlorine, and biochemical oxygen demand are conducted by base personnel. There have been no major problems with discharges from the base wastewater treatment plant.

Surface-Water Use

Surface-water in the immediate vicinity of Sheppard AFB is used for contact recreation, non-contact recreation, and propagation of fish and wildlife (Texas Department of Water Resources, 1981). Irrigation of crop land is also a major use of the surface water. Wichita County Water Improvement District Number 2 maintains approximately 250 miles of canals and lateral canals plus Lake Kemp and Lake Diversion. These canals and lakes provide farmers with access to the surface water.

Public water supply for Wichita Falls is obtained principally from Lake Arrowhead and Lake Kickapoo, which along with Lake Kemp and Lake Diversion are located southwest and south of the base (Texas Department of Water Resources, 1983). The base obtains its water supply from Wichita Falls. The Wichita Falls water supply intakes are upstream of Sheppard AFB discharges.

GROUND-WATER RESOURCES

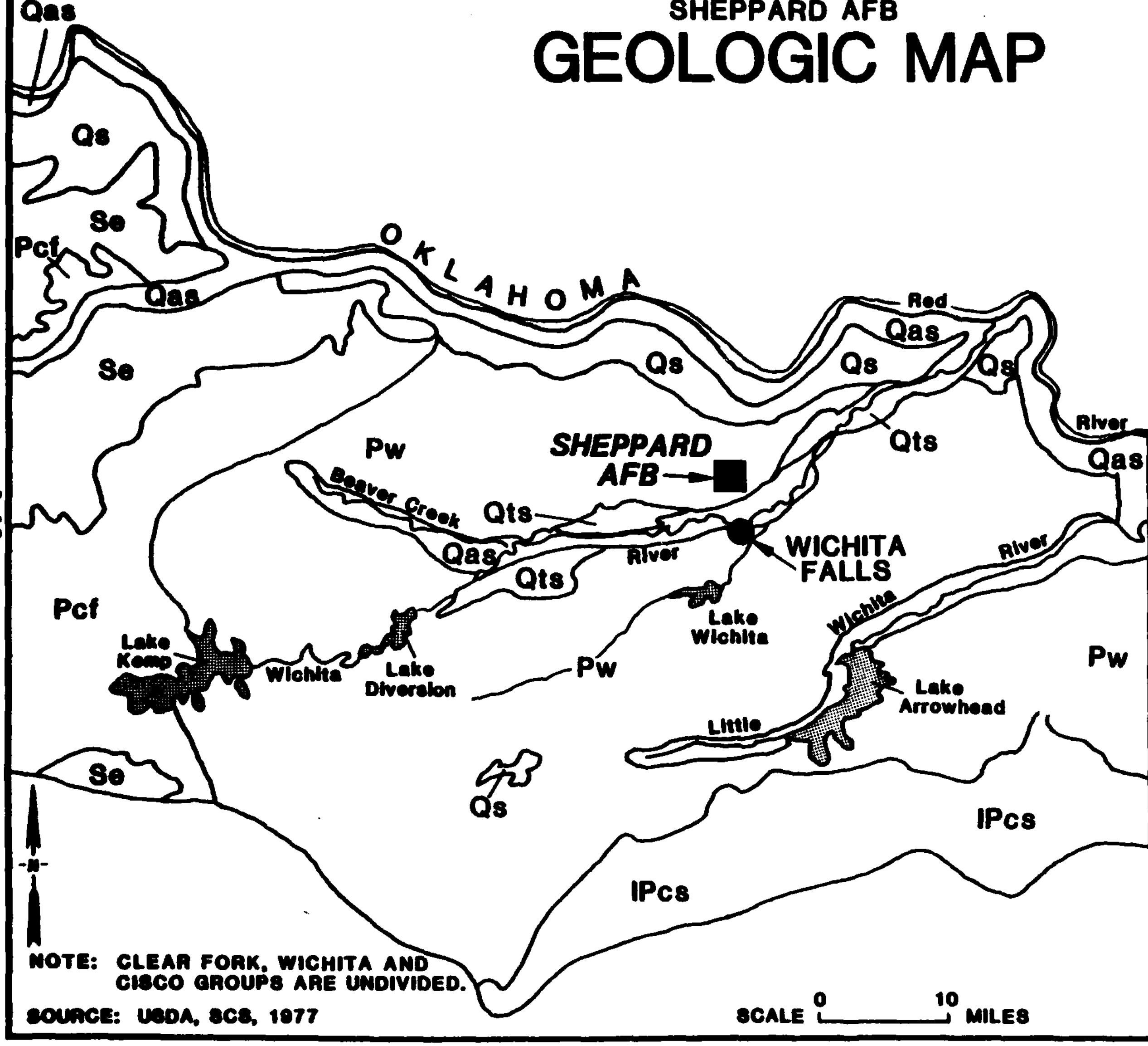
The ground-water resources in the immediate vicinity of Sheppard AFB are not abundant due to the shale bedrock and the abundance of clay. The bedrock itself and overlying clay deposits have low permeabilities; therefore they do not yield significant volumes of water to wells. Reports by Baker, et al. (1963), Fink and Merritt (1976), USDA (1977), Muller and Price (1979), and Price (1979) describe the ground-water resources of the region.

Hydrogeologic Units

Geologically, Sheppard AFB is located in the outcrop area of the Wichita Group (undivided) (Figure 3.7). The Wichita Group (undivided)

SHEPPARD AFB

GEOLOGIC MAP



LEGEND

Qas	ALLUVIUM
Qts	TERRACE DEPOSITS
Qs	WINDBLOWN SAND
Se	SEYMOUR FORMATION
Pcf	CLEAR FORK GROUP
Pw	WICHITA GROUP
IPcs	CISCO GROUP

NOTE: CLEAR FORK, WICHITA AND CISCO GROUPS ARE UNDIVIDED.

SOURCE: USDA, SCS, 1977

SCALE 0 — 10 MILES

is composed of shale, sandstone, and limestone. Table 3.4 summarizes the hydrogeologic units and their water-bearing characteristics. The only hydrogeologic units of significant water-bearing importance in the regional vicinity of the base are the Alluvium and the Terrace Deposits south of the Red River. These units supply ground water to the cities of Burkburnett, Thornberry, and Friberg Cooper.

The sediments on the base overlying the Wichita Group (undivided) have been penetrated by numerous test borings. The deepest boring (No. H-1) was 65 feet deep and encountered shale bedrock at 32 feet below ground (Figure 3.8). Soft sandstone and sandy shale were encountered at depths of 1.6 and 3 feet, respectively. The shale on base and off base in the immediate vicinity is a distinctive red color, hence the driller's nomenclature is "shale red bed" on most boring logs. Two generalized subsurface cross sections are located on Figure 3.9. Figures 3.10 and 3.11 are cross sections A-A' and B-B', respectively. The preponderance of clay and shale is very evident. The depth to the top of bedrock (shale or sandstone) ranges from 2 to 32 feet below ground.

Hydrologically, Sheppard AFB is located in a limited ground-water area. Due to the shale bedrock and the overlying clay deposits wells in the Wichita Group (undivided) yield very little water. In addition, the water is usually too highly mineralized to be of use for drinking water (Baker, et al., 1972). The fact that the ground-water resources are limited is reflected in two very apparent hydrogeologic elements. These elements are a lack of significant recharge and low subsurface permeabilities. The lack of significant recharge is due to the negative net precipitation and the low permeability values for the surface soils on the base. Recharge may occur as surface streams and ponds lose water to the subsurface, but the low permeability clay and rock in the subsurface limit the amount of stream and pond losses.

Surface soils and upper sections of weathered bedrock may form shallow (probably perched) ephermal aquifers, locally. The apparent lithology of the unit is highly variable, including clay, sandy clay, soft sandstone, sandy silt, and isolated sections of sandy shale. Most of the unit is composed of clay (see cross-sections, Figures 3.10 and 3.11). Water occurs in the unit at depths of ten to thirty feet below ground (from installation test borings) where present. In some areas of

TABLE 3.4
HYDROGEOLOGIC UNITS AND THEIR WATER-BEARING CHARACTERISTICS
IN THE VICINITY OF SHEPPARD AFB

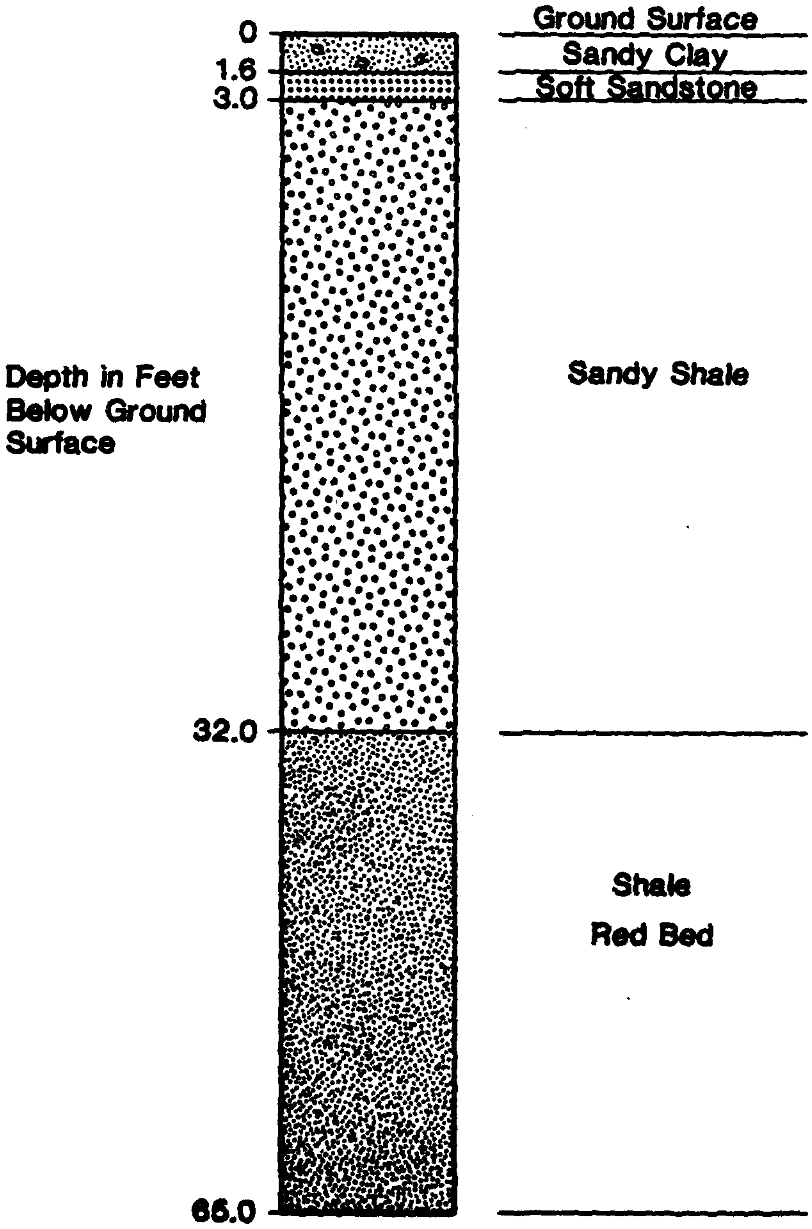
System	Series	Group	Hydrogeologic Unit	Hydrogeologic Classification	Approximate Thickness (Feet)	Dominant Lithology	Water-Bearing Characteristics
Quaternary	Recent to Pleistocene		Alluvium, Wind-blown Sand and Terrace Deposits	Unconfined Aquifers	60	Sand, silt, clay and gravel.	Moderately transmits water; yields small to moderate amounts of water to wells along rivers and major tributaries.
			Seymour Formation	Unconfined Aquifer	112	Sand, silt, clay and gravel.	Moderately transmits water; yields small to moderate amounts of water to wells in extreme northwest corner of Wichita County.
Permian	Leonard	Clear Fork Group, undivided		Unconfined Aquifer	1,350	Dolomite, limestone and shale.	Moderately transmits water; yields small to moderate amounts of water to wells in extreme northwest corner of Wichita County.
	Wolfcamp	Wichita Group, undivided		Unconfined and Confined Aquifers	670	Shale, sandstone and limestone.	Moderately transmits water. Yields small amounts of water which is usually too highly mineralized for use.
Pennsylvanian	Upper	Cisco Group, undivided		Unconfined and Confined Aquifers	1,000	Shale, sandstone, limestone and conglomerate.	

Source: USDA, SCS, 1977; Price, 1979 and Baker, et al., 1963.

FIGURE 3.8

SHEPPARD AFB

TEST BORING LOG NO. H-1

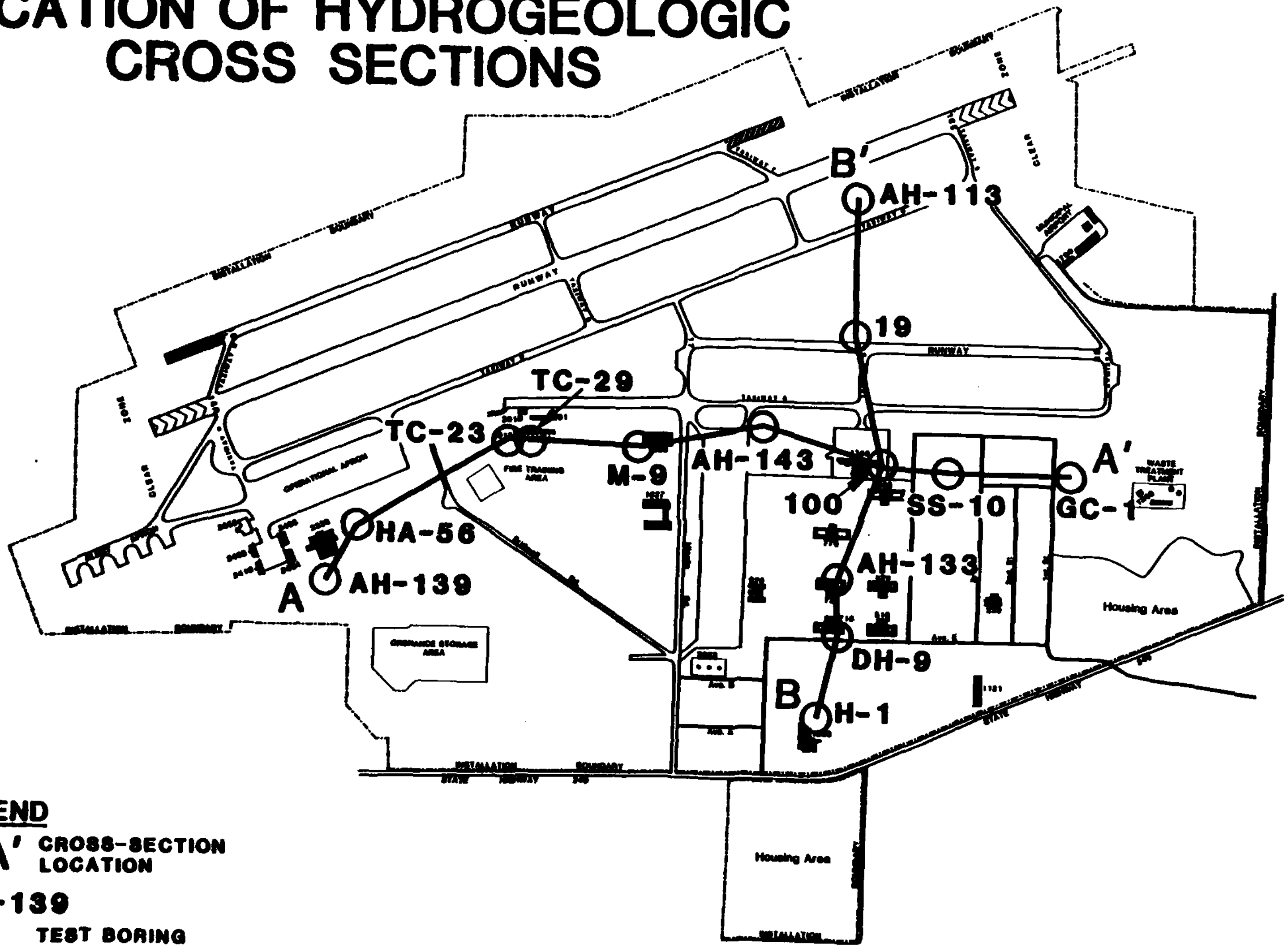


NOTE: SEE FIGURE 3.9 FOR TEST BORING LOCATION

SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

FIGURE 3.9

SHEPPARD AFB
LOCATION OF HYDROGEOLOGIC CROSS SECTIONS



LEGEND

A-A' CROSS-SECTION LOCATION

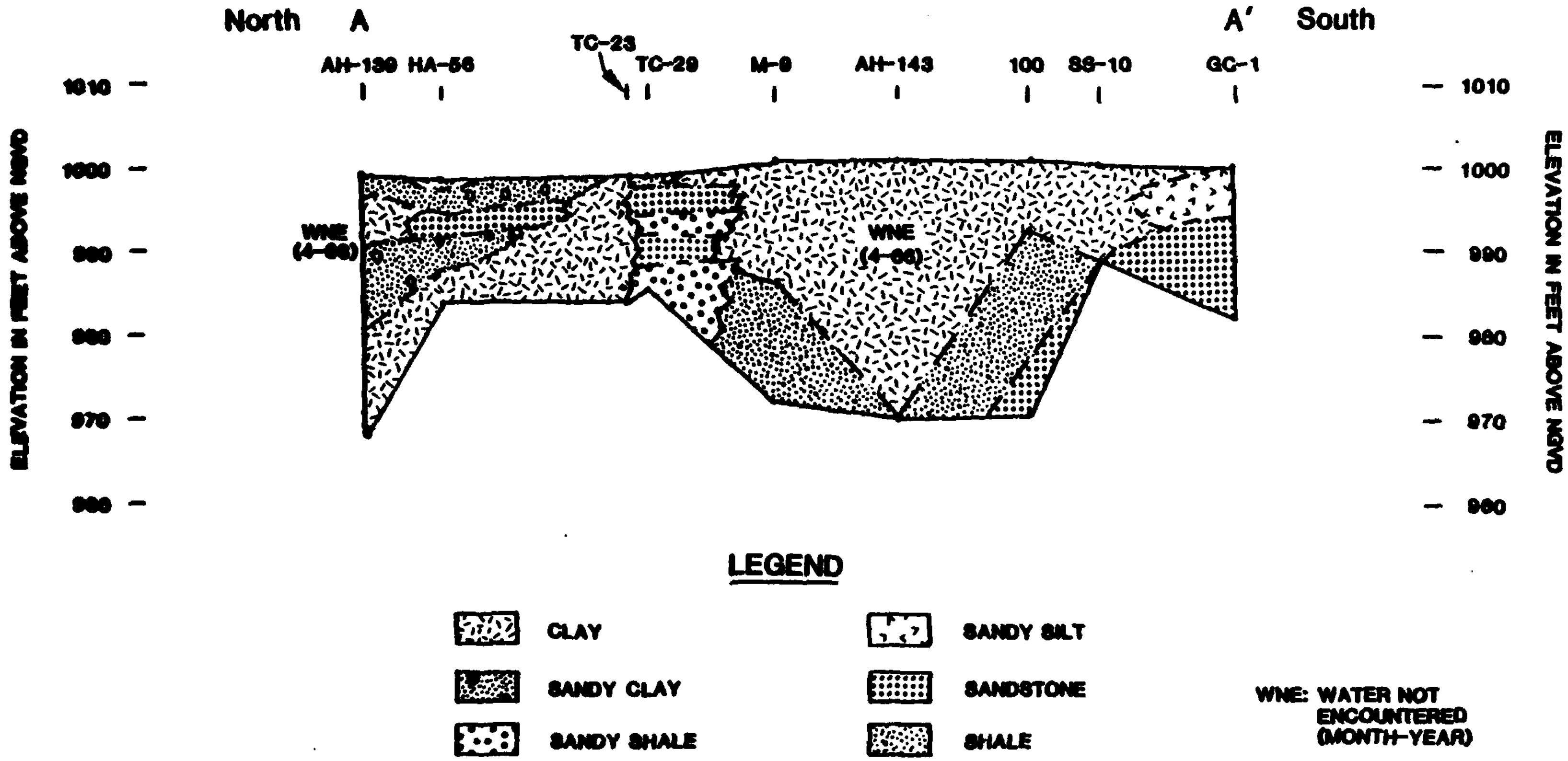
AH-139 ○ TEST BORING

SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

FIGURE 3.10

SHEPPARD AFB

HYDROGEOLOGIC CROSS SECTION A – A′



WNE: WATER NOT ENCOUNTERED (MONTH-YEAR)

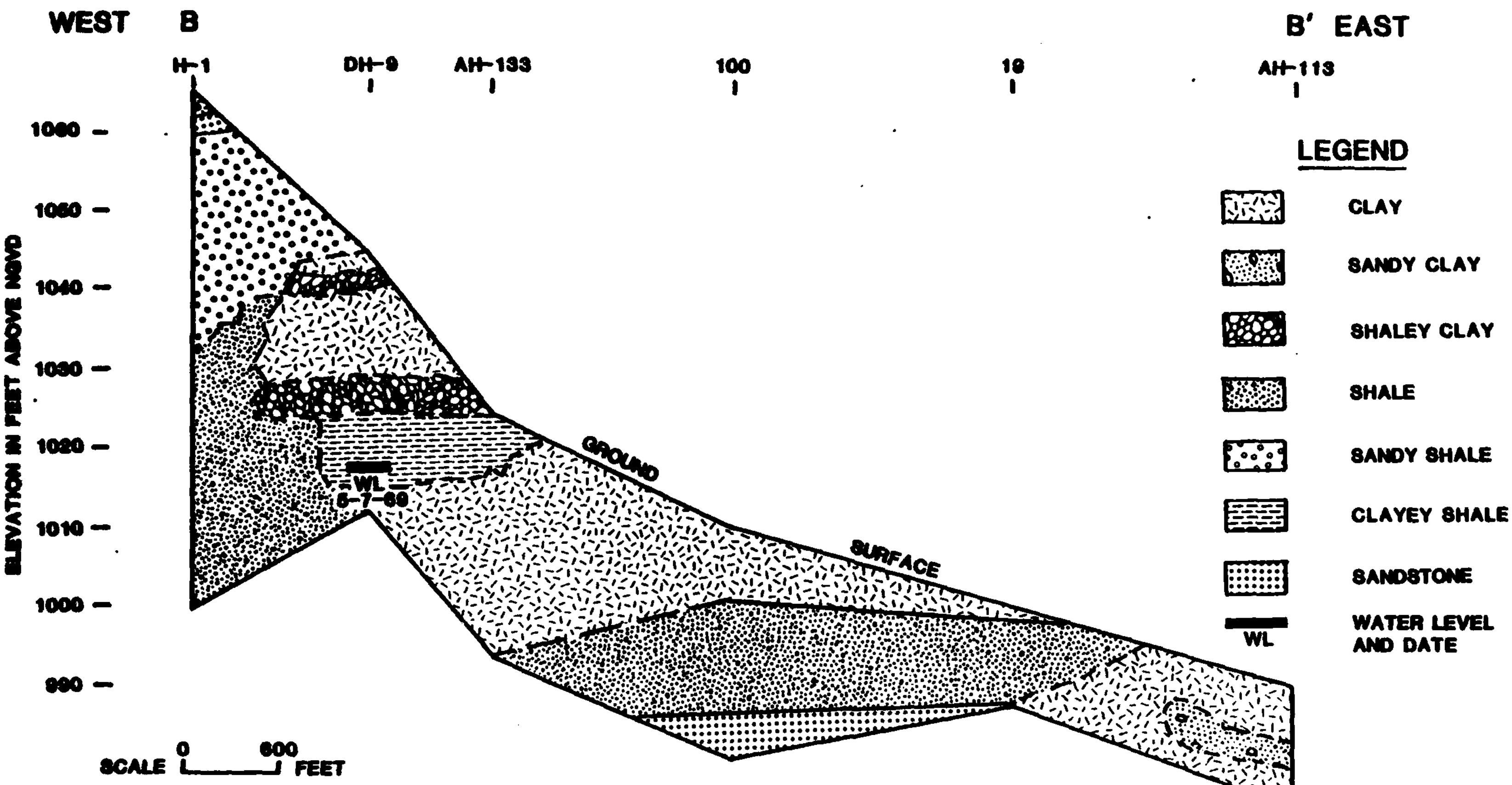
NOTE SEE FIGURE 3.9 FOR CROSS SECTION LOCATION.
GROUND WATER PRESENCE OR ABSENCE WAS NOT RECORDED ON SOME TEST BORING LOGS.
VERTICAL SCALE IS GREATER THAN HORIZONTAL SCALE.

SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

SCALE 0 1200 FEET

SHEPPARD AFB

HYDROGEOLOGIC CROSS SECTION B – B′



NOTES: GROUND WATER PRESENSE OR ABSENCE WAS NOT RECORDED ON SOME TEST BORING LOGS.
VERTICAL SCALE IS GREATER THAN HORIZONTAL SCALE.

SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

FIGURE 3.11

the base, no ground water was encountered, suggesting that this "aquifer" may contain water only seasonally, or be limited areally, due to changes in lithology which occur across base land areas. Test boring data suggest that the geologic materials occurring on base may become more fine-grained, tighter, and therefore less permeable with increasing depth (for example, at Boring H-1, below 32 feet). this change in geologic conditions would tend to restrict the vertical movement of fluids in favor of the horizontal. It is likely that the shallow materials receive little recharge from precipitation or from seasonal stream flow derived from intermittent drainage. Discharge would likely be directed to local drainage alignments and not to deeper aquifers. Ground-water flow directions in this unit are generally unknown and probably quite variable locally.

Ground water normally occurs at depths of less than 10 feet deep, but it has been observed as deep as 32 feet below ground. In some areas of the base soil test borings did not encounter any ground water. Based on test boring logs with water level data the areas near Buildings 716 and 1900 did not contain ground water in the late 1960's. In contrast, areas near the operational apron contained ground water at 1.5 feet below ground (Stroman, 1983). The presence of shallow ground water in the operational apron area may be due to several reasons. These reasons are the close proximity of subsurface drainage pipes, the relatively permeable crushed limestone base underlying the apron and the effect of heat on the apron during hot summer days. The abnormal heat may cause an upward piping effect of moisture in the unsaturated zone. A subsurface drainage system has been installed to alleviate high ground-water levels in this area.

Due to the limited ground-water resources on the base no definite pattern of ground-water flow is known. General ground-water flow directions are from areas of high hydraulic heads to areas of low hydraulic heads. Streams and ponds may recharge the water table on the base. Flow directions in and adjacent to subsurface disturbed areas such as pits and landfills may be highly variable. Water-table fluctuations on the base have not been recorded, but are suspected to be relatively stable due to the lack of significant recharge and the low to moderate permeabilities.

Ground-Water Quality

Ground-water quality in the immediate vicinity of the base is poor due to limited recharge and highly mineralized waters related to oil and gas development near the base. Numerous oil and gas wells in the area have encountered mineralized water in the Wichita and Cisco Groups (undivided) (Baker, et al., 1972). One test well drilled west of the base in the 1920's encountered natural gas at shallow depths of 50 and 120 feet deep. One dry test well was drilled 1,850 feet deep on the property of the old Wichita Falls Airport. The date of drilling and exact location are unknown (Heidecker, 1983). The quality of ground water in the Alluvium and Terrace Deposits north of the base is good and wells in the area along the Red River supply ground water to drinking water wells.

Ground-Water Use

Ground water is not used on Sheppard AFB and only very limited drinking water and livestock use in the vicinity is known. If ground water is used in the vicinity, only a limited number of very shallow dug wells or shallow drilled wells are utilized. The very shallow wells are placed adjacent to ponds as to withdraw water from the shallow sediments saturated by pond water infiltration. A chlorination unit is usually connected to the drinking water pumping system. No records of wells in the vicinity are available (Threadgill, 1984).

The only significant use of ground water in the regional vicinity is by the cities of Burkburnett, Thornberry, and Friberg Cooper north of the base. Ground water is withdrawn from wells tapping the Alluvium and Terrace Deposits which do not occur on base (Figure 3.7). The average depth of the approximately 100 wells in this area is 40 to 45 feet below ground. The wells yield between 3 and 50 gallons per minute (Sprole, 1983). These wells are approximately four miles north and northeast of Sheppard AFB. The Alluvium and Terrace Deposits from which the wells obtain water are not considered to be hydraulically connected to the limited ground water underlying Sheppard AFB.

BIOTIC ENVIRONMENT

Within the regional vicinity of Sheppard AFB five species of animals have been listed as endangered by Federal or Texas agencies (Texas Parks and Wildlife Department, 1983). They are as follows:

Black-footed ferret (weasel)
Southern bald eagle
Eskimo curlew
Whooping crane
Peregine falcon

The Texas kangaroo rat is listed as a threatened species by the U.S. Fish and Wildlife Service (Mapston, 1983). There are no endangered or threatened species on Sheppard AFB. The only permanent animal inhabitants of the base are quail, mourning doves, owls, and rabbits. Selected ponds on base have been stocked with bass, catfish, and sunfish.

SUMMARY OF ENVIRONMENTAL SETTING

The environmental setting data for Sheppard AFB indicate the following data are important when evaluating past hazardous waste disposal practices.

1. The mean annual precipitation is 27.08 inches; the net precipitation is -36.92 inches and the 1-year 24-hour rainfall event is estimated to be 2.8 inches. These data indicate that there is little or no potential for precipitation to infiltrate the surface soils on the base. Also, there is a moderate potential for runoff and erosion.
2. The natural soils on the base are typically loam and combinations of sandy, silty, and clayey loam with low to moderate permeabilities. These data indicate that recharge by precipitation infiltrating the soils will be slow.
3. Surface water, the most important drinking water resource for the area, is controlled on base by open ditches, concrete-lined ditches, and underground storm drainage mains.

4. An ephemeral, shallow and probably perched aquifer may underly the base locally. A major constituent of this unit is clay or clay-bearing materials. Ground-water, if present, may occur at depths of ten to thirty feet below land surface. The unit is underlain by even tighter, less permeable bedrock. Ground-water movement in the shallow unit likely favors the horizontal.
5. The shallow aquifer present on base is not known to be hydraulically connected to an aquifer providing potable water supplies. The shallow unit is considered to be a poor source of water.
6. No water supply wells have been identified within three miles of the base. It is possible that private supply wells could be present in the rural areas around the base. Private wells, should they exist, would be small wells probably constructed in the infiltration zone of small ponds. It is unlikely that any nearby wells could be hydraulically connected to the shallow units on base.
7. Bedrock (shale and sandstone) is present at shallow depths (less than 30 feet) and is not important as an aquifer in the vicinity of the base.
8. There are no Federally or State listed endangered or threatened species which inhabit the base.

A review of these major findings indicates that pathways for the migration of hazardous waste-related contamination exist. Contaminants present at ground surface would likely be mobilized to local drainage alignments via the shortest flow path. The shallow perched aquifer encountered on base is primarily a clay-bearing material of low permeability which contains water only seasonally and is not known to be hydraulically connected to any other aquifers of regional significance. Movement within this unit, should contaminants gain access, would probably favor the horizontal. Since it is underlain by even tighter materials, the migration of waste-related contamination to deeper zones is considered to be unlikely.

SECTION 4

FINDINGS

This chapter summarizes the hazardous waste generated by past activity, describes past waste disposal methods, identifies the disposal and spill sites located on the base, and evaluates the potential for environmental contamination.

REMOTE ANNEXES REVIEW

A review of files and records and interviews with present and past base employees were carried out to identify past activities at all remote base annexes which could have resulted in the disposal of hazardous waste. The Lake Texoma Annex was surveyed aerially. The Lake Texoma Annex has a permitted waste discharge into the lake from the sanitary waste package treatment system, and one area has been used as a waste landfill in the recent past (see Figure 2.3). Only normal refuse has been disposed of in the Lake Texoma landfill. Any waste POL, such as from vehicle maintenance, has been collected and returned to the base for disposal with base-generated POL. The Frederick Auxiliary (Frederick, Oklahoma Municipal Airport) was determined to have no potential for contamination from facilities used by Sheppard AFB.

The City of Wichita Falls has leased since 1959 a 54-acre land parcel from Sheppard AFB for use as the Wichita Falls Municipal Airport. The site is located on the east side of the main runway on the base property. The leased property houses the main terminal, a small maintenance hangar, and three 20,000 gallon fuel storage tanks. Only two of the fuel storage tanks are used. One stores jet fuel and the other stores AVGAS. The minor amounts of waste chemicals, oil, or fuel generated from maintenance operations of the airport are removed from the site by a contractor. No significant spills are known to have occurred on the site. The domestic wastes generated at the airport are piped to the Sheppard AFB sewage treatment plant.

PAST SHOP AND BASE ACTIVITY REVIEW

To identify past base activities that resulted in generation and disposal of hazardous waste, a review was conducted of current and past waste generation and disposal methods. This activity consisted of a review of files and records, interviews with present and former base employees, and site inspections.

The source of most hazardous wastes on Sheppard AFB can be associated with one of the following activities:

- o Industrial operations (shops)
- o Fire protection training
- o Pesticide utilization
- o Fuels management
- o Waste storage sites
- o Spills and leaks

The following discussion addresses only those wastes generated on Sheppard AFB which are either hazardous or potentially hazardous. In this discussion a hazardous waste is defined as hazardous by the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). A potentially hazardous waste is one which is suspected of being hazardous, although insufficient data are available to fully characterize the waste material.

Industrial Operations (Shops)

Industrial operations at Sheppard AFB primarily consist of activities which support the maintenance of training aircraft used at the base, support general base operations (eg. civil engineering, vehicle maintenance, and fuels management) or support the training courses which are conducted in association with the Technical Training Wing. Many of these activities utilize hazardous materials and generate hazardous wastes. The Bioenvironmental Engineering Services (BES) Office provided a listing of industrial shops which, along with interviews, was used as a basis for evaluating past waste generation and hazardous material disposal practices. The BES records and shop files were utilized to determine hazardous material usage and hazardous waste generation and

disposal practices. From this information, a master list of shops was prepared showing building locations, hazardous materials handlers, hazardous waste generators, and typical treatment, storage, and disposal methods. The list appears as Appendix E.

Those shops which were determined to be generators of hazardous wastes which pose a potential for ground-water or surface-water contamination were selected for further investigation and evaluation. During the site visit, interviews were conducted with personnel from many of these industrial shops, including the shops that generate the largest amounts of hazardous wastes. Additional shops generating lesser amounts of hazardous wastes were contacted by telephone. Shop interviews focused on hazardous waste materials, waste quantities, and disposal methods. Disposal timelines were prepared for each major hazardous waste from information provided by shop personnel and others familiar with the shop's operations and activities.

Table 4.1 summarizes the information obtained from the detailed shop review including information on present and past shop locations, identification of hazardous wastes, current or most recent estimates of waste quantities, and disposal method. If significant changes in generation rates were found with time, these are noted under the waste quantity heading. Table 4.1 does not include the shops which generate insignificant quantities of hazardous wastes.

The disposal of industrial wastes has been handled in a variety of manners over the history of the base. During the early period of base activities (1940's to late 1960's) most of the combustible industrial wastes (i.e., oils, hydraulic fluids, and solvents) were taken to the fire protection training area and burned during training exercises. However, some of the wastes may have been disposed of in the landfills used during the period. During the late 1960's until the mid 1970's, waste oils were either sold or applied to dirt roads on the base to control fugitive dust. The chemical wastes were taken to disposal pits located at the northwest side of the base and buried. By the mid 1970's chemical wastes were typically accumulated in storage areas and eventually hauled off-base by a contractor. Used oils, fuels, and hydraulic fluids were removed from the base by contractors.

TABLE 4.1

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
SCHOOL OF HEALTH CARE SCIENCES (SHCS)				
DEPARTMENT OF DENTISTRY	1919	FIXER SOLUTION	5 GALS./MO.	1966 SILVER RECOVERY →
DEPARTMENT OF RADIOLOGY	1900	FIXER SOLUTION	20 GALS./WK.	SILVER RECOVERY →
USAF REGIONAL HOSPITAL SHEPPARD	DISMANTLED HOSPITAL LOCATED ADJACENT TO CURRENT HOSPITAL (1940-1963)			
DENTAL CLINIC	1200	FIXER SOLUTION	5 GALS./MO.	1940 SANITARY SEWER - - - → SILVER RECOVERY →
RADIOLOGY CLINIC	1200	FIXER SOLUTION	30 GALS./MO.	SANITARY SEWER - - - → SILVER RECOVERY →
OPERATING ROOM	1200	PATHOLOGICAL WASTES	NO ESTABLISHED QUANTITY	- - - INCINERATED →
VETERINARY CLINIC	61	PATHOLOGICAL WASTES	NO ESTABLISHED QUANTITY	- - - INCINERATED - - - →
3700 TECHNICAL TRAINING WING (TCHTW)				
TRAINING SERVICES/AUDIOVISUAL DIVISION	844	FIXER SOLUTION	400-500 GALS./YR.	SANITARY SEWER 1949 → 1963 SILVER RECOVERY →

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940–1980)
3750 AIR BASE GROUP				
AUTO HOBBY SHOP	55	USED OIL	150-200 GALS./WK.	1949 CONTRACT DISPOSAL
		SOLVENT	40 GALS./2 WKS.	CONTRACT DISPOSAL
BX COMPLEX	1126/1400	USED OIL HYDRAULIC FLUID	55 GALS./MO.	CONTRACT DISPOSAL
3750 TECHNICAL TRAINING GROUP (TCHTG)				
MISSILE BRANCH	1900	MEK METHANOL (USED UNTIL 1981) HYDRAULIC FLUID CLEANING FLUIDS FREON	35 GALS./YR.	1965 CONTRACT DISPOSAL
3770 TECHNICAL TRAINING GROUP (TCHTG)				
CORROSION CONTROL COURSE	1928 (907 PAST)	WASTE PAINT THINNERS, MEK	55 GALS./2 MOS.	BURNED IN FIRE TRAINING PIT; 1968 CHEMICAL PITS; 1975 CONTRACT DISPOSAL
ENTOMOLOGY COURSE	1929 (903 PAST)	EMPTY CONTAINERS	6-10 CONTAINERS/YR.	RINSED, CRUSHED GENERAL REFUSE
		RINSATE	20-55 GALS./MO.	STORM DRAIN; SANITARY SEWER
SITE DEVELOPMENT COURSE	1927 (2001 PAST)	TRICHLOROETHANE	1 GAL./2 MOS.	1965 DISPOSED WITH CORROSION CONTROL COURSE WASTE

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
3770 TECHNICAL TRAINING GROUP (CONT'D)				
HELICOPTER COURSE	1040	PD-680	15-20 GALS./YR.	BURNED IN FIRE TRAINING PIT; CHEMICAL PITS; 1975 STORED FOR CONTRACT DISPOSAL
		ENGINE OIL	2-3 GALS./YR.	STORED FOR CONTRACT DISPOSAL
POWER PRODUCTION	2001	USED OIL	55 GALS./MO.	BURNED IN FIRE TRAINING PIT 1965; 1968 CONTRACT DISPOSAL
3750 CIVIL ENGINEERING				
GOLF COURSE MAINTENANCE	4493	HERBICIDE CONTAINERS	6-7 CONTAINERS/MO.	RINSED CONTAINERS DISPOSED WITH GENERAL REFUSE
ENTOMOLOGY	1391	PESTICIDE CONTAINERS	10 CONTAINERS/MO.	1940 RINSED CONTAINERS DISPOSED WITH GENERAL REFUSE
		RINSATE	20 GALS./MO.	DISPERSED IN ADJACENT GRAVEL LOT
POWER PRODUCTION	1506	PD-680	55 GALS./3 MOS.	STORM DRAIN 1983
		USED OIL	55 GALS./3 MOS.	BURNED IN FIRE TRAINING PIT; 1968 CONTRACT DISPOSAL
INTERIOR/EXTERIOR ELECTRICS	1501	PCB TRANSFORMERS	AS REQUIRED	CONTRACT DISPOSAL
3750 TRANSPORTATION DIVISION	2130	USED OIL	50-150 GALS./MO.	1940 BURNED IN FIRE TRAINING PIT; APPLIED ON ROADS FOR DUST CONTROL 1968; 1975 CONTRACT DISPOSAL
		HYDRAULIC FLUID	100 GALS./MO.	BURNED IN FIRE TRAINING PIT; APPLIED ON ROADS FOR DUST CONTROL; CONTRACT DISPOSAL
		SOLVENTS	55 GALS./2 MOS.	BURNED IN FIRE TRAINING PIT; 1965 CHEMICAL PITS; 1976 CONTRACT DISPOSAL
3750 AIR BASE GROUP				
PAINTING PLANT	T-60	FIXER SOLUTION	3 GALS./MO.	SANITARY SEWER; SILVER RECOVERY

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL (1940 – 1950 – 1960 – 1970 – 1980)
2750th CONSOLIDATED MAINTENANCE SQUADRON				
CORROSION CONTROL/WASH RACK	1360	MEK TOULENE NAPHA SODIUM PEROXIDE THINNER PAINT REMOVER	55 GALS./2 MOS.	1940 BURNED IN FIRE TRAINING PIT – 1968 CHEMICAL PITS – 1976 CONTRACT DISPOSAL
PMEL	1364	MERCURY	SMALL QUANTITIES	CONTRACT DISPOSAL
BATTERY AND ELECTRICAL/ ENVIRONMENTAL SYSTEMS	1360	BATTERY ACID	6 GALS./2 MOS.	NEUTRALIZED TO SANITARY SEWER
PNEUDRAULIC SHOP	1360	HYDRAULIC FLUID	55 GALS./YR.	BURNED IN FIRE TRAINING PIT – CHEMICAL PITS – CONTRACT DISPOSAL
AIRCRAFT TRAINER MAINTENANCE	1060	USED OIL HYDRAULIC FLUID PD-680	55 GALS./YR.	BURNED IN FIRE TRAINING PIT – 1968 CHEMICAL PITS – 1976 CONTRACT DISPOSAL
NORTHROP CONTRACTOR (1972–PRESENT) SERVTOR CONTRACTOR (1966–1972)				
NDI LAB	2412	EMULSIFIERS	110 GALS./ ONE TIME DISPOSAL	CONTRACT DISPOSAL 1983
		PENETRANT	220 GALS./ ONE TIME DISPOSAL	CONTRACT DISPOSAL
		TRICHLOROETHYLENE	55 GALS./ ONE TIME DISPOSAL	CONTRACT DISPOSAL

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
NORTHROP CONTRACTOR SURVEYOR CONTRACTOR (CONT'D)				
T-38 UNSCHEDULED SHOP	2404	PD-680	200 GALS./YR.	1966 CONTRACT DISPOSAL
		HYDRAULIC FLUID	100 GALS./YR.	CONTRACT DISPOSAL
		JP-4	2500 GALS./YR.	CONTRACT DISPOSAL
		USED OIL	3000 GALS./YR.	CONTRACT DISPOSAL
ENGINE SHOP	2320	PD-680	55 GALS./YR.	CONTRACT DISPOSAL
		PAINT REMOVER	55 GALS./YR.	CONTRACT DISPOSAL
		CALIBRATING FLUID	25 GALS./YR.	CONTRACT DISPOSAL
		SOLVENT DEGREASER	150 GALS./YR.	CONTRACT DISPOSAL
		CARBON REMOVER	1100 GALS./YR.	CONTRACT DISPOSAL
		CORROSION REMOVER	330 GALS./YR.	CONTRACT DISPOSAL
		FINGERPRINT REMOVER	10 GALS./YR.	CONTRACT DISPOSAL
HYDRAULICS SHOP	2320	HYDRAULIC FLUID	6 GALS./MO.	CONTRACT DISPOSAL
		PD-680	220 GALS./MO.	CONTRACT DISPOSAL 1966

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)

INDUSTRIAL OPERATIONS (Shops)

Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
NORTHROP CONTRACTOR SURVEYOR CONTRACTOR (CONT'D)				
TIRE SHOP	2320	PD-680	220 GALS./MO.	1966 CONTRACT DISPOSAL
SCHEDULED DOCK SHOP	2406	HYDRAULIC FLUID	300 GALS./YR.	CONTRACT DISPOSAL
		PREMIUM MOTOR OIL	3 GALS./YR.	CONTRACT DISPOSAL
		PD-680	200 GALS./YR.	CONTRACT DISPOSAL
T-37 UNSCHEDULED	2408	LUBE OIL	6 GALS./WK.	CONTRACT DISPOSAL
		HYDRAULIC FLUID	20 GALS./MO.	CONTRACT DISPOSAL
AGE SHOP	2406	STEAM ENGINE OIL	110 GALS./YR.	CONTRACT DISPOSAL
		ENGINE OIL	15 GALS./MO.	CONTRACT DISPOSAL
		LUBE OIL	3 GALS./YR.	CONTRACT DISPOSAL
		AIRCRAFT ENGINE OIL	8 GALS./MO.	CONTRACT DISPOSAL
		SULFURIC ACID	10 GALS./MO.	1966 NEUTRALIZED TO SANITARY SEWER

KEY

——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL

- - - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

TABLE 4.1 (cont'd)
INDUSTRIAL OPERATIONS (Shops)
Waste Management

SHOP NAME	LOCATION (BLDG. NO.)	WASTE MATERIAL	WASTE QUANTITY	METHOD(S) OF TREATMENT, STORAGE & DISPOSAL 1940 1950 1960 1970 1980
NORTHROP CONTRACTOR SURVEYOR CONTRACTOR (CONT'D)				
CORROSION CONTROL	2402	PD-680	55 GALS./MO.	CONTRACT DISPOSAL
		ALKALINE CLEANING COMPOUND	55 GALS./MO.	1966 SANITARY SEWER
VEHICLE MAINTENANCE	2340	ENGINE OIL	200 GALS./YR.	CONTRACT DISPOSAL
ELECTRIC SHOP	2320	PD-680	50 GALS./YR.	CONTRACT DISPOSAL
FLIGHT LINE	2534	AIRCRAFT ENGINE OIL		
		LUBE OIL	65 GALS./MO.	CONTRACT DISPOSAL
		JP-4		
MARS-K-II SHOP	2320	PD-680	120 GALS./YR.	CONTRACT DISPOSAL
EGRESS	2404	PD-680	5 GALS./MO.	CONTRACT DISPOSAL
		MEK	1 GAL./MO.	CONTRACT DISPOSAL
PAINT SHOP	2404	PAINT SLUDGE	110 GALS./YR.	DISPOSED IN LANDFILL 1966; CONTRACT DISPOSAL 1976
WELDING SHOP	2320	CADMIUM PLATING SOLUTION	310 GALS./ ONE TIME DISPOSAL	CONTRACT DISPOSAL
		COPPER PLATING SOLUTION	70 GALS./ ONE TIME DISPOSAL	CONTRACT DISPOSAL
		CHROME PLATING SOLUTION	50 GALS./ ONE TIME DISPOSAL	NEUTRALIZED TO SEWER 1982

KEY
——— CONFIRMED TIME-FRAME DATA BY SHOP PERSONNEL
- - - - - ESTIMATED TIME-FRAME DATA BY SHOP PERSONNEL

The Strategic Air Command (SAC), which was at Sheppard from 1956 until 1966 and which occupied the area currently housing the Northrop contractor, disposed of their industrial waste in the same manner as that used for the disposal of other base wastes.

The maintenance of the T-37 and T-38 training aircraft was contracted out to private companies beginning in 1966. The Surveyor Company was contracted for maintenance services between 1966 and 1972. Since 1972 the contract for maintenance of the trainer aircraft has been awarded to the Northrop Corportion. Many of the personnel utilized by Surveyor continued in a similar capacity with the Northrop Corporation. The maintenance contract included the responsibility for disposing of the wastes generated and therefore the contractors removed most hazardous wastes from the Air Force premises.

Operations Conducted During Period of Base Inactivity

From August 1946 to August 1948, Sheppard AFB was in an inactive status. During that time a "caretaker staff" was assigned to the base, but no significant activity was conducted. Base facilities were not in use during this time. As a consequence, no significant hazardous waste generation is associated with this period.

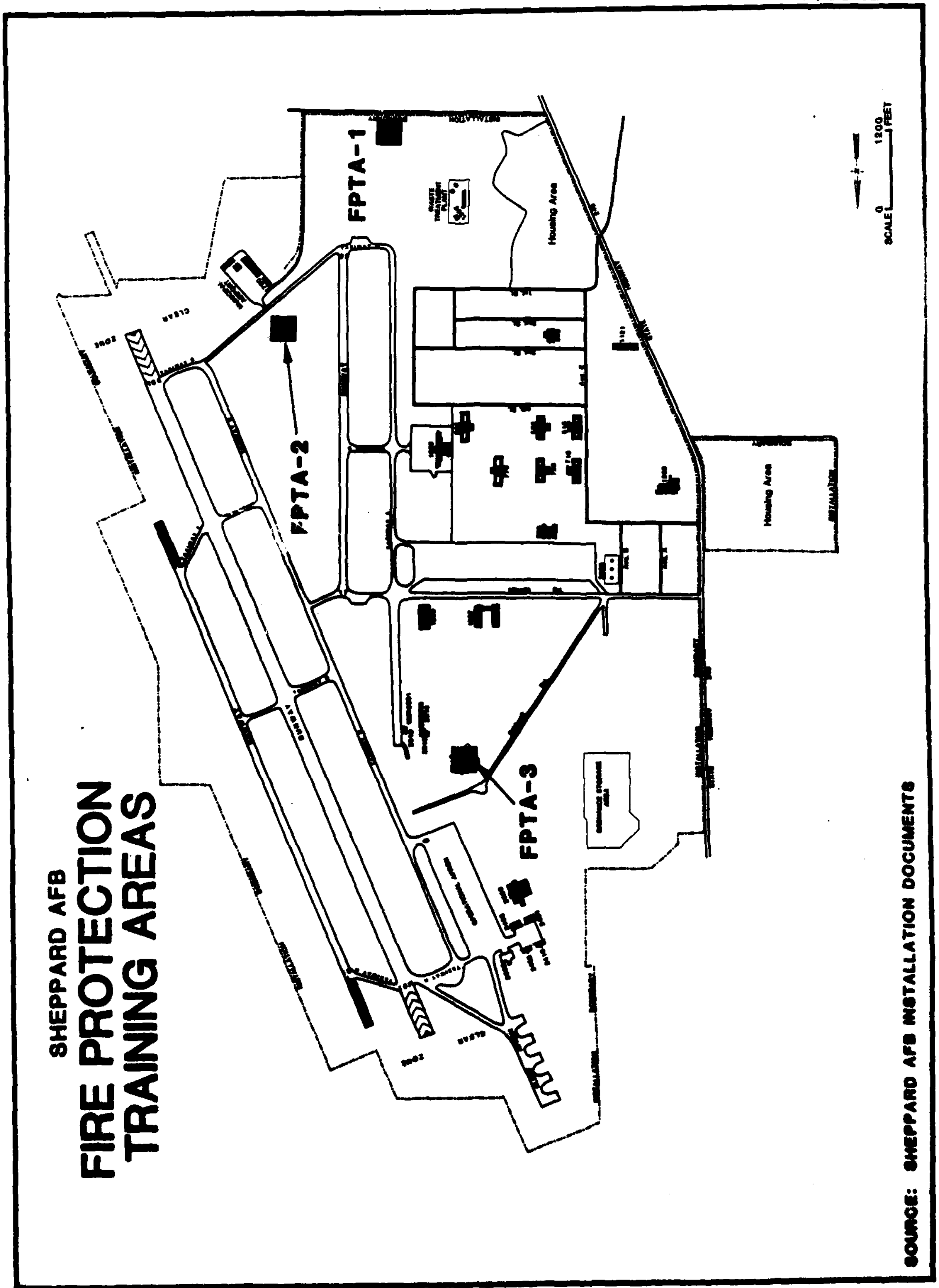
Fire Protection Training

The Fire Department at Sheppard AFB has operated three fire training sites at which fires were ignited and then extinguished. Fire extinguishing agents have included water, AFFF, protein foam, and Halon. Each of these sites is illustrated in Figure 4.1 and is described in the discussion which follows.

FPTA-1 Fire Protection Training Area No. 1

Site FPTA-1, located adjacent to the landfill which is the present site of the base golf course, was used as a fire protection training area from the 1940's until 1957. Appendix F contains several aerial photographs which show this site during and soon after its period of use. The site consisted of a depressed burning area and three old aircraft. A drum storage area north of and adjacent to the site was used to store between 100 and 200 55-gallon drums of contaminated oils, fuels, and waste solvents from aircraft maintenance and industrial shop activities. The frequency and duration of burns during the 1940's is unknown. During the 1950's, the drums were transported by

FIGURE 4.1



SHEPPARD AFB
FIRE PROTECTION
TRAINING AREAS

SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

flat-bed truck from the drum storage area to the fire protection training site, the drums were drained, and burns occurred. During the 1950's, four or five burns occurred each weekend day, and each burn constituted about 400 to 500 gallons of material. As far as can be determined, no drainage collection system was operational at this site.

Visual examination of the area presently reveals no remaining sign that the site was once a fire protection training area. The site is presently well filled in and is a part of the greens of the base golf course. Due to the nature and duration of the activity at this site and the relatively shallow depth to groundwater, a potential for contaminant migration exists since much of the unburned material probably seeped into the ground.

FPTA-2 Fire Protection Training Area No. 2

Site FPTA-2, located north of the municipal airport terminal and Taxiway C, was used as a small-scale fire protection training area from about 1968 until about 1976. This area was used as a fire training area by the Local Base Rescue (LBR) group. Typical usage constituted one burn of contaminated oil, fuels, and solvents every three to six months. An oil-water separator connected to a storm drain exists at the site.

The surface soils in this area have been disturbed for construction of runways. Adjacent soils are composed of silty loam with relatively low permeabilities. Ground water may occur at less than ten feet below ground. A nearby test boring for runway 33L encountered clay from 0 to 13 feet deep with two minor lenses of gravel less than six inches thick at 7 and 11 foot depths.

FPTA-3 Fire Protection Training Area No. 3

Site FPTA-3, located adjacent to the northern corner of the old municipal runway (presently Bridwell Road), was activated in 1957 when FPTA-1 was closed for construction of the golf course. This site is in use at the present time. The site consists of a storage area containing three 2,000-gallon, elevated tanks, a concrete block building for structures fire training, a mock-up of a T-38 used for fire training, a C-130A aircraft for rescue training, and a waste drainage and collection system. The drainage and collection system, installed in 1982, consists

of drainage collection and piping leading to an oil-water separator, and a water storage pond. The unburned fuel which drains into the oil-water separator is pumped to the storage tanks for reuse, and the water phase flows to the pond, from which it discharges to the sanitary sewer. Present burn frequency is approximately quarterly, and about 300 gallons of fuel is consumed per burn. Prior to 1982, no waste collection and separation system was in operation at this site.

Natural soils in the area of FPTA-3 are composed of silty loam with relatively low permeabilities. Ground water may occur at less than ten feet below ground. A nearby test boring at Building 2013 encountered clay from 0 to 15 feet below ground.

Visual examination of the area during the site visit indicated only surficial contamination and a fuel odor. Due to the duration and frequency of operations and the lack of a waste oil reclamation facility until recently, a potential for contaminant migration exists for the site.

Pesticide Utilization

Pesticide applications have been performed by the Entomology shop, Golf Course Maintenance, and Roads and Grounds. Golf Course Maintenance and Roads and Grounds have had responsibility for the application of herbicides. In 1979, the responsibility for herbicide application around the base areas other than the golf course was delegated to the Entomology Shop. A listing of the pesticides on-hand at the time the study was conducted is included in Appendix D, Table D-1. The Entomology Shop has always been located in Building 1380 adjacent to the waste treatment plant. This building has been used for both storing and mixing the chemicals. Rinse water generated from cleaning the application equipment and empty containers has been dispensed over a gravel lot adjacent to the building. Rinsed containers have been crushed and disposed of with general refuse. No significant pesticide spills are known to have occurred at the base. Some unused pesticides were occasionally submitted to DPDO for resale. For example, in 1981 a small quantity (approximately five gallons) of Chlordane dust was transferred to DPDO. Also, final off-base disposed of DDT occurred in December 1981 through DPDO.

Fuels Management

The Sheppard AFB Fuels Management Storage System consists of a number of above-ground and underground storage tanks in various locations around the base. A list of the major storage tanks is tabulated in Appendix D, Table D.2. Fuel and oil used on the base includes JP-4, AVGAS, Diesel, MOGAS (leaded and unleaded), oils, and natural gas (heating). JP-4 fuel is pumped to the base from the Continental Oil Company Refinery Tank Farm through a 4-inch diameter - approximately 4 mile long pipeline. The tank farm is located south of the base on Highway 240. JP-4 fuel is also transported to the base in tank trucks.

The major above-ground tanks are located in the Bulk Storage Area. All three tanks in this area contain JP-4. One tank holds 1,100,000 gallons while the other two tanks hold 825,000 gallons each. From the Bulk Storage Area fuel is pumped through an 8-inch diameter underground pipe to the Operational Apron. East of the Operational Apron fuel is stored in 18 underground tanks from which, when needed, it is pumped through eight Hydrant Lateral Control Pits and on to 40 Hydrant Outlets underneath the Operational Apron. Four of the eight Hydrant Lateral Control Pits are in use. The remaining four hydrants are not required for the present mission of the base and are in a standby status. All hydrants are in good condition.

In addition to the underground tanks at the Operational Apron, seven underground tanks are located in the Jet Fuel Storage Area near Buildings 2000, 2003, 2015, and 2017. These tanks hold JP-4, diesel, and MOGAS. Underground tanks at the Base Service Station (Building 1126) hold leaded and unleaded MOGAS.

Waste fuel and oil are collected and/or stored in numerous dump tanks, oil/water separators, and grease traps throughout the base. The collection/storage locations are tabulated in Table D.3. A plan for the management of recoverable and waste liquid petroleum products was adopted in April 1982. Cleaning of fuel tanks and leak testing of tanks are conducted periodically. No indications of leaks have arisen from the leak tests. Tank sludges are removed from the base by a contractor.

Waste Storage Sites

At the present time, waste materials are stored at several locations on Sheppard Air Force Base, as follows:

1. Temporary storage at the site of waste generation.
2. Short-term storage at four designated Hazardous Waste Accumulation Points (HWAP).
3. Above ground storage at FPTA-3 for contaminated jet fuel to be burned in fire protection training.
4. Waste oil tank at Motor Pool and other waste petroleum product collection points.
5. Methanol drum storage at north end of base near the SAC aircraft apron.

There are numerous hazardous waste generation sites on the base; these are summarized in Table 4.1 of this report and in the Sheppard Air Force Base Hazardous Waste Management Plan (STTC Plan 708). Containers for small volume generators are normally five gallon to 55 gallon drums, all Department of Transportation (DOT) approved. Since 1982 the filled containers have been transported to one of four hazardous waste accumulation points (HWAPs); prior to 1982 the containers were left at the point of generation for contractor pickup.

The three 2,000 gallon above ground tanks located at the present fire protection training area are used to store fuels and recycled fuels from the drainage collection separator system. No evidence of leakage from these tanks was evident, and they appeared to be in good condition.

A 2,000 gallon above ground waste oil storage tank is located adjacent to the Motor Pool. Waste fuel and oil volumes in excess of those which can be handled temporarily at the generation site are transported to this tank in drums and drained into the tank. The contents of this tank as well as the contents of drums, bowsers, and smaller tanks at the waste petroleum products generation points are disposed of by contract recycle through DPDO. The location and description of the waste POL generation and storage sites are described in Sheppard Technical Training Center Plan 211, Management of Recoverable and Waste Liquid Petroleum Products.

At the time of the site visit, six 55-gallon drums of pure methanol were stored at an open-air location adjacent to the SAC aircraft apron at the northwest corner of the base. These drums were electrically

grounded, and were in contact with the ground. It was stated by base personnel that the drums were stored at that location only temporarily, pending off-site disposal by DPDO.

Spills and Leaks

Numerous small spills of fuels and oils were confirmed by base records and interviews with base personnel. These spills were usually onto paved areas and were contained with absorbent materials or washed into the drainage system to the nearest oil-water separator. As a result, no potential for environmental contamination is associated with these small spills.

No spills of note from underground tanks have been found. Inventory checks of non-petroleum materials have been performed and no discrepancies have been noted. Yearly leak tests are performed on POL tanks, and no leaks have been found. Four notable spills of hazardous materials have been confirmed by interviews with base personnel. The locations of these four sites are shown in Figure 4.2.

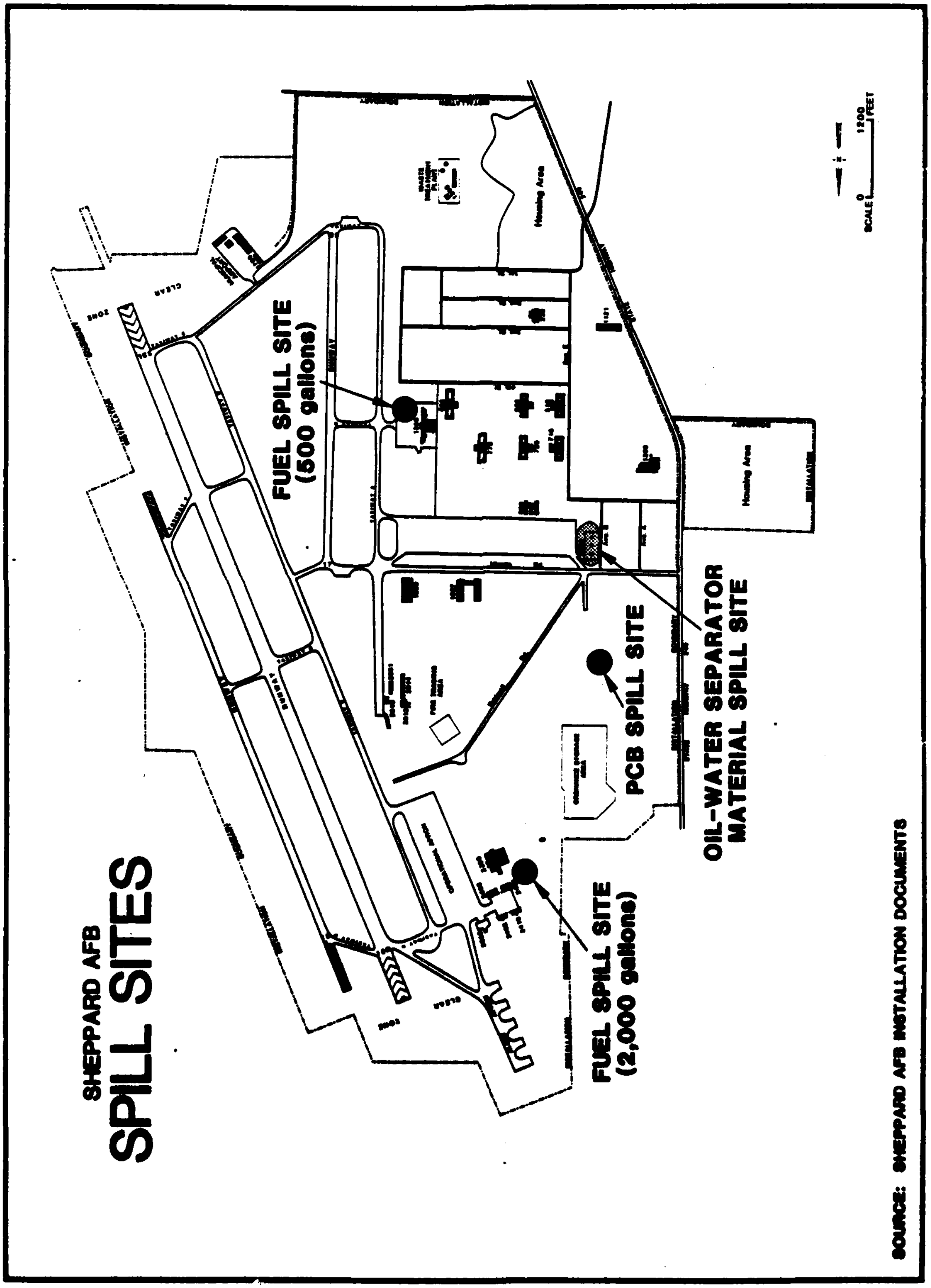
A quantity of JP-4 estimated at 500 gallons was released from a F-4C aircraft onto the base operations apron on one occasion during 1981. The fuel was washed into the drainage system to the oil-water separator nearby, and no release to the environment occurred.

Also during 1981, a 2,000-gallon fuel spill occurred at the 80th FTW area. This fuel ran to a French drain which drained to the storm water system. The material was diverted to an oil-water separator and was captured; no release to the environment occurred.

During 1983, a spill occurred from a contractor's truck which was hauling material pumped from an oil-water separator. Approximately 800 gallons of the material spilled into a ditch at the POL area; the spill was contained and removed, and no release to the environment occurred.

A small spill of PCB-containing liquid dielectric material occurred during 1983. An out-of-service transformer stored in the DPDO storage yard prior to disposal leaked a small quantity (less than one pint) of dielectric liquid onto an asphalt-paved area. The transformer was removed and the contaminated asphalt was removed and disposed of off-site by a contractor. As a result of the measures taken, no release of PCB's to the environment is associated with this event.

FIGURE 4.2



SHEPPARD AFB
SPILL SITES
FUEL SPILL SITE (500 gallons)
FUEL SPILL SITE (2,000 gallons)
PCB SPILL SITE
OIL-WATER SEPARATOR MATERIAL SPILL SITE
Housing Area
Housing Area
SCALE 0 1200 FEET
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

DESCRIPTION OF PAST ON-BASE TREATMENT AND DISPOSAL METHODS

The facilities on Sheppard AFB which have been used for the management and disposal of waste can be categorized as follows:

- Landfills
- Hardfill Disposal Area
- Waste Pits
- Surface Impoundments
- Munitions Storage Area
- Low-level Radioactive Waste Disposal
- Incineration
- Sanitary Wastewater Treatment
- Storm Water Drainage System
- Oil - Water Separators
- Pesticide Rinse Water Disposal

These facilities are discussed individually in the following subsections.

Landfills

On-base landfills at Sheppard AFB have been used for disposal of non-hazardous solid wastes and some industrial waste materials. Landfills were operated at three locations, as shown in Figure 4.3. Table 4.2 contains a summary of information pertaining to these landfills.

Landfill No. 1

Landfill No. 1 was operated from the 1940's until about 1957, when it was completely closed and graded for installation of the base golf course. Some portions of the landfill, namely those on the west side of the fill, were closed about 1952 and base housing was constructed on the area. Precise dimensions of the total area used as landfill are uncertain, but aerial photographs and interviews with base personnel indicate approximate boundaries; placement of these boundaries gives a total landfill area of approximately 100 acres. The landfill was a trench and fill operation, with trenches about 14 feet deep running east-west. Burning of wastes at the site occurred regularly throughout its period of use. The wastes were primarily normal base refuse, but some additional materials were disposed of, including incinerator ash, sludge

FIGURE 4.3

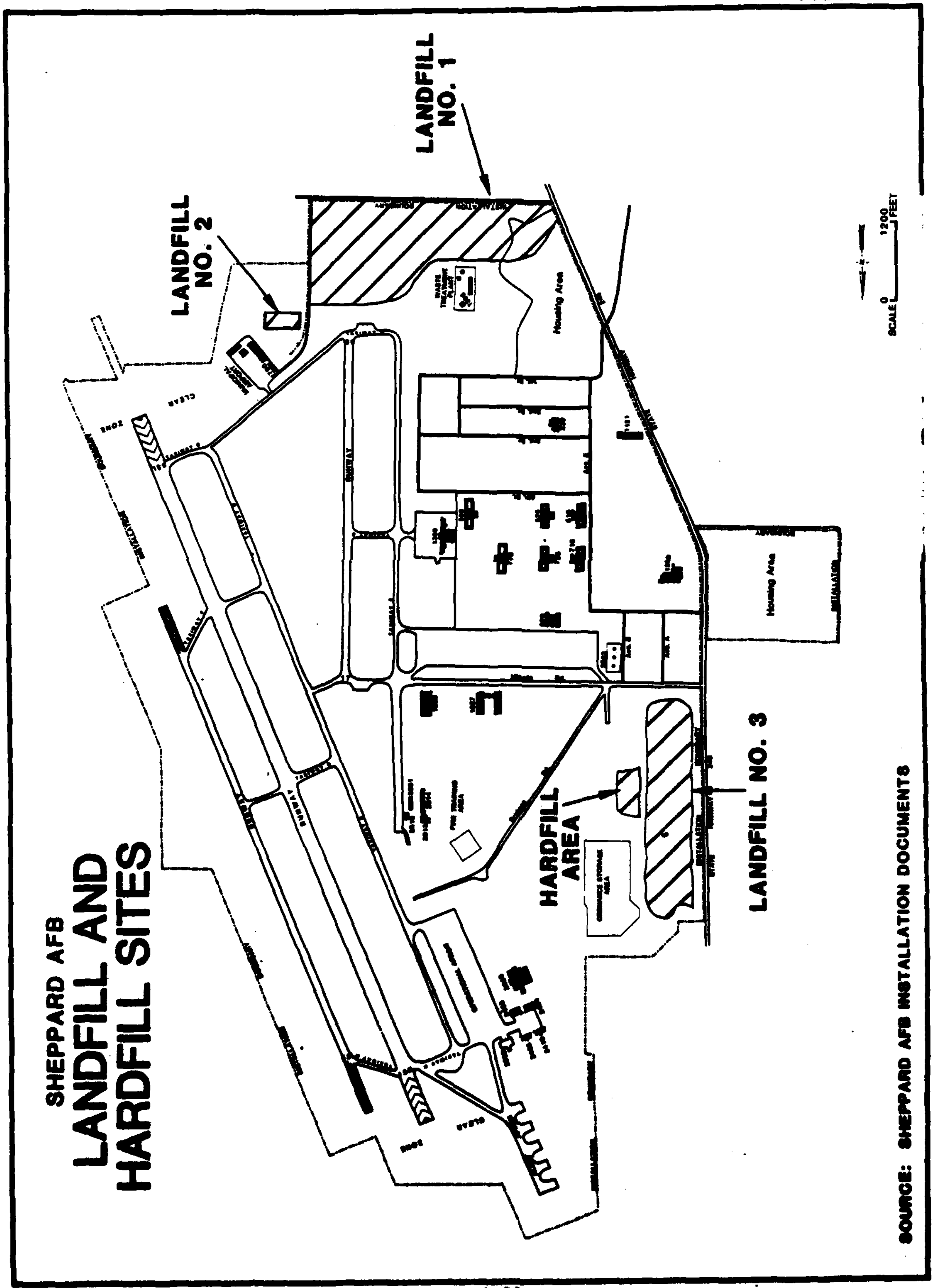

SHEPPARD AFB
LANDFILL AND
HARDFILL SITES
LANDFILL NO. 1
LANDFILL NO. 2
LANDFILL NO. 3
HARDFILL AREA
Housing Area
Housing Area
SCALE 0 1200 FEET
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

TABLE 4.2
SUMMARY OF LANDFILL DISPOSAL SITES

Landfill Designation	Operation Period	Approximate Site (Acres)	Type of Waste	Method of Operation	Closure Status	Surface Drainage
No. 1	1940's - 1957	100	General refuse, flyash, waste treatment sludge	Trench and fill	Closed, covered, base golf course and base housing constructed over site.	To unnamed tributary of Plum Creek and to small ponds on golf course.
No. 2	early 1960's for about 3 yr.	7	General refuse	Trench and fill	Closed, present use is base Prime BEEF and Security Police training area.	To small ponds off base and to unnamed tributary draining into Northside Canal.
No. 3	1957 - 1972	90	General refuse, waste treatment sludge, industrial waste oils.	Trench and fill	Closed, covered, presently as open field.	To unnamed tributary of Bear Creek.

from the waste treatment plant drying beds, and some hardfill and construction rubble. Important considerations at this landfill site are the adjacent structures, which included the waste treatment plant, a small low-level radioactive waste disposal well, an early fire protection training area, and an ordnance building. The waste treatment facility and radioactive waste well are in the area north of the landfill site; the other structures were removed for golf course construction. Refuse burning was performed without added fuel during the time of operation of this landfill. Most waste combustible liquids were used in fire protection training, so it is assumed that little or no waste fuel and oil was deposited in this landfill.

Landfill No. 2

Landfill No. 2 was a rectangular-shaped area approximately seven acres in size. It was located south of the present Municipal airport complex, and was operated for about three years during the early 1960's. Landfill operations entailed trench and full procedures; trenches ran east-west and were approximately 10 to 14 feet deep. As far as can be determined, only normal base refuse was disposed of in this landfill. Burning of the refuse was performed during the period of use. Aerial photographs reveal the general contour of the trenches, since settling has occurred since closing (see Appendix F). At the present time the landfill area is covered with natural local vegetation; the site formerly occupied by the trenches contains a growth of mesquite trees which is noticeably more dense than that of the surrounding area.

Landfill No. 3

Landfill No. 3, comprising about 60 acres at the northwest corner of the base, was operated from about 1957 until 1972. The landfill area is located east of State Highway 240, and in an area bounded approximately by Missile Road, the Motor Pool area, the Munitions Storage area, and the City of Wichita Falls treatment facility property. The material disposed of in this landfill was primarily normal base refuse and some waste treatment sludge; the operation was performed as trench and fill with east-west trenches approximately 14 feet deep. Burning of the refuse occurred until 1968, after which no further burning was performed. The pattern of use was that the landfill was opened first near the Missile Road area, and was progressively opened north to

northeast, so that by the early 1970's the area of use was west of the Munitions Storage area. From about 1965 to about 1970, trenches were dug at the north area of the landfill near Munitions Storage and waste oils were dumped into the trenches along with refuse and covered. Volume estimates ranged from one 55-gallon drum of waste oil per week to one 55-gallon drum per day. A marked low-level radioactive waste burial site is located in the landfill area, west of the south end of the Munitions Storage area. This site is discussed further in a later subsection of this chapter.

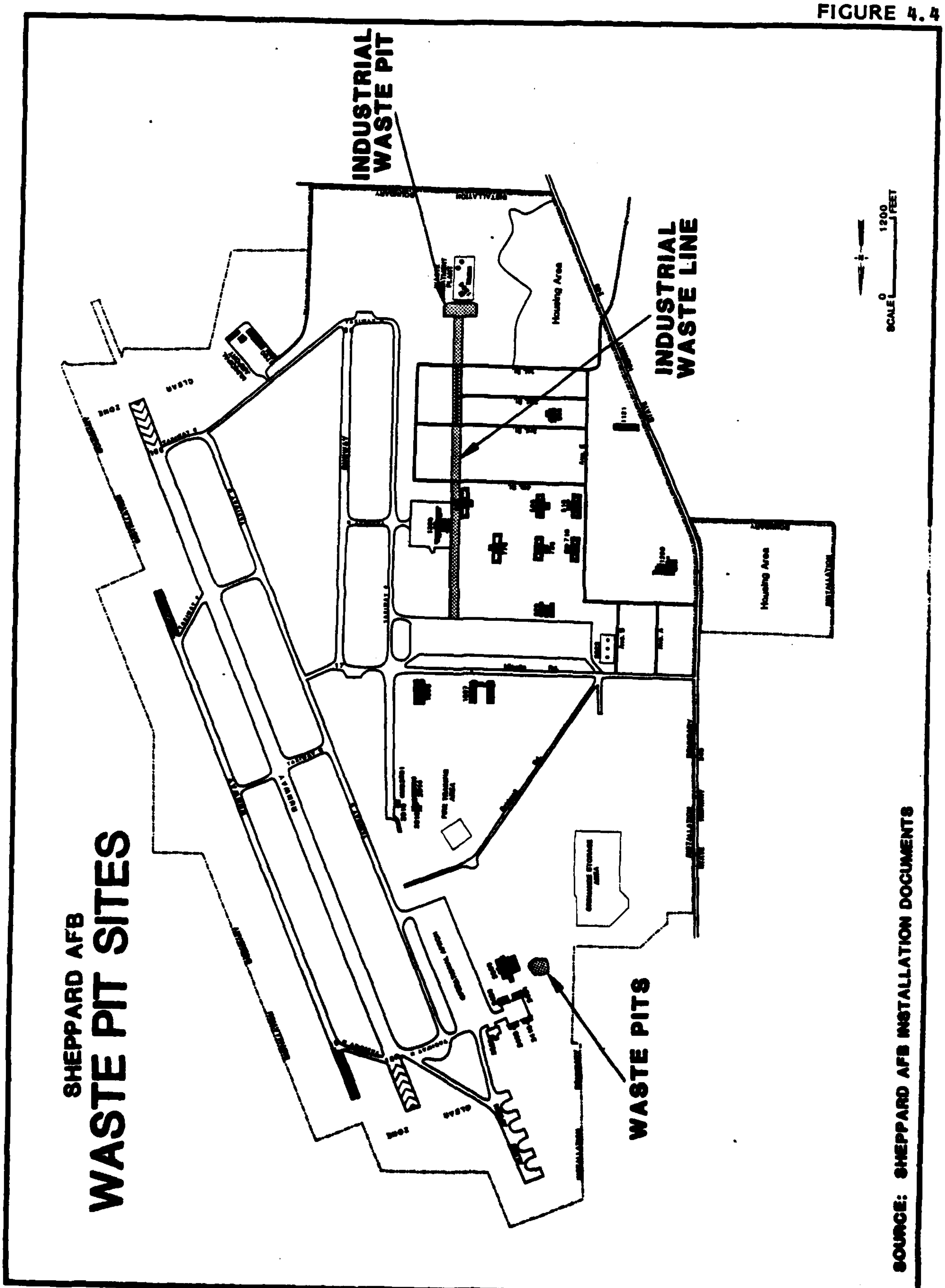
Hardfill Disposal Area

A disposal area for hardfill and other construction rubble has been operated at a site adjacent to Landfill No. 3 and about 800 feet southwest of the southwest corner of the Munitions Storage area (see Figure 4.3). Interviews with base personnel and examination of aerial photographs provide an indication that the hardfill disposal site was used beginning in the mid 1960's and continues in limited use at the present time. When first opened, the site was used primarily for normal base refuse; after the addition of construction rubble from the 1964 tornado damage of the Sheppard Hospital, the site was used as a hardfill area. As far as can be determined, no waste fuels, solvents, or oils were disposed of in this area. At the present time, scrap concrete, brush, tree stumps, and scrap metal are visible at the surface of the area, and the area slopes downward to an unnamed creek on the northwest side. No vegetation is present on the site at the present time. A storage area for bulk construction and paving materials presently is situated just southwest of the area.

Waste Pits

Three waste pits were excavated to contain waste engine cleaning fluids and solvents from nearby maintenance buildings in 1966. These pits were directly across Avenue H from Building 2325 (see Figure 4.4). The pits were approximately 60 feet in diameter and 10 feet deep, and were unlined. On one occasion in the late 1960's an adjacent storm pond overflowed and carried some of the waste pit contents into the storm water system and hence into Plum Creek. The pits were most actively used from 1966 to the mid 1970's.

FIGURE 4.4



SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

An earthen industrial waste pit just north of the waste treatment facility was used during the 1950's as a storage pond for waste oils and fuels from the old engine test cells. An industrial waste line ran south from the test cells to the pit. The oils in the pit were burned on at least one or two occasions during the 1950's. The pit is no longer used for industrial waste storage. The present use of the pit is as an overflow basin for the effluents from the oil-water separator.

Surface Impoundments

Several surface impoundments are present on Sheppard AFB. These are the following:

- o Storm pond
- o Fire protection training pond
- o Pond near waste treatment plant

These impoundments are discussed individually in the following subsections.

Storm Pond

An earthen construction storm water pond is located west of Avenue H and southwest of the former site of the waste pits. This pond, when filled, is approximately 100 feet wide and 400 feet long. The discharge from this pond is through a standpipe to the underground storm drainage system.

Fire Protection Training Pond

Within the boundary of the fire protection training area (FPTA-3) and south of the T-38 aircraft mockup is a pond used for collection and storage of the aqueous phase of the drainage from the fire protection training area. The pond is approximately 60 feet square, of earthen construction, and drains into the sanitary sewer system by a standpipe. This pond was constructed as part of the refurbishing of the fire protection training area (FPTA-3) performed during 1981. Inspection at the time of the site visit revealed no hydrocarbon layer in the pond.

Pond Near Waste Treatment Plant

A small impoundment, about 20 feet square, is present adjacent to the radioactive waste disposal well near the waste treatment plant. This impoundment was installed at an undetermined date for use as a

storage pond for digestor sludge when repairs to the digestor were needed. As far as can be determined the pond was used on one occasion for its intended purpose. Presently it contains water, and it was reported by base personnel that fish now live in the pond waters.

Munitions Storage Area

At the northwest end of the base is the Munitions Storage Area. This area is used for storage of explosive ordnance and for marksmanship practice. Due to the nature of the materials and the location of the site, no potential for contamination exists due to the activities of the Munitions Storage Area.

Low-level Radioactive Waste Disposal Areas

Two low-level radioactive waste disposal areas are present on Sheppard AFB. These are a small disposal well adjacent to the waste treatment plant and a buried vault in Landfill No. 3 (see Figure 4.5).

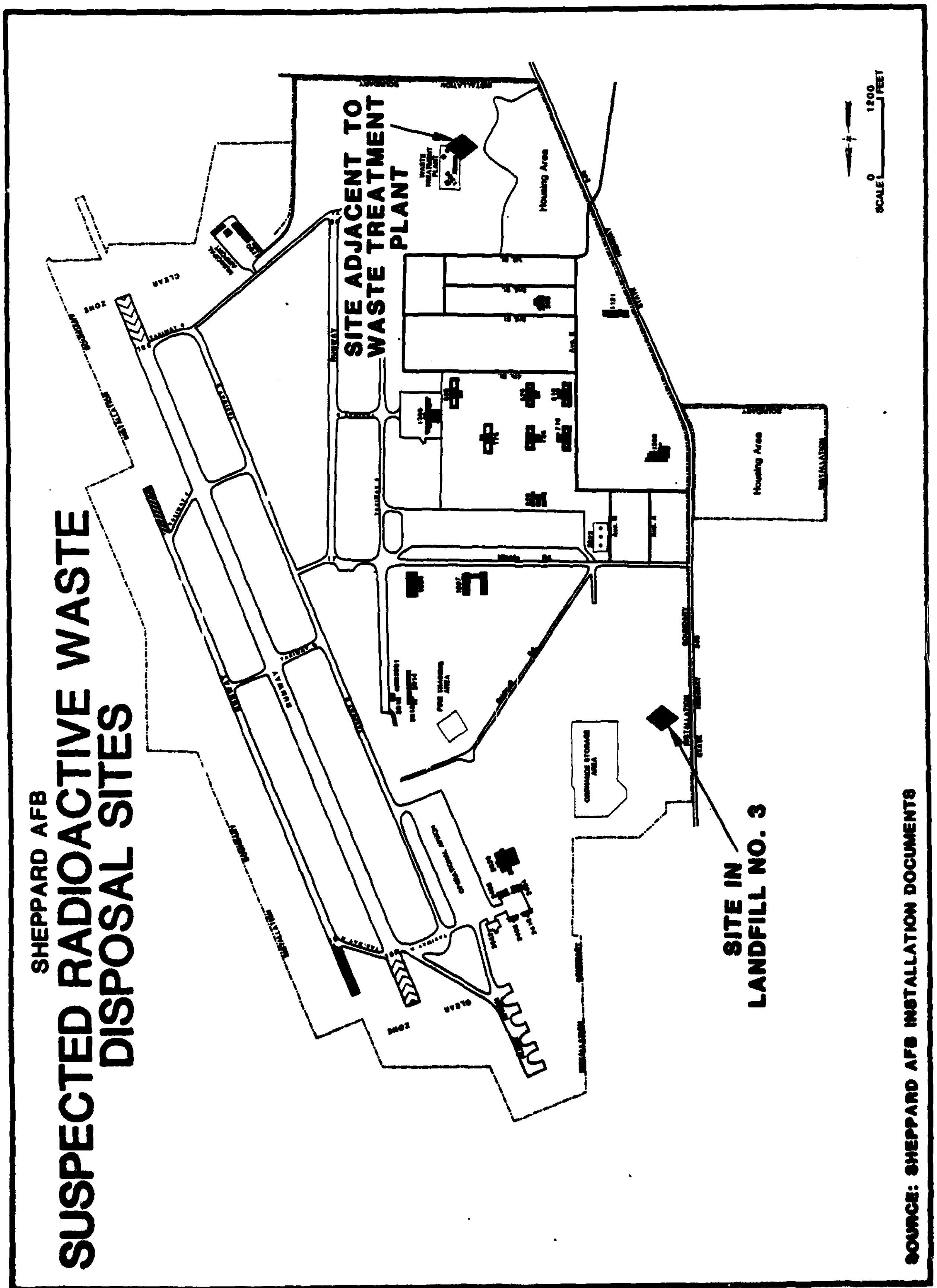
The disposal well adjacent to the waste treatment plant is concrete-lined, about six inches in diameter and 14 feet deep, and is surrounded by a locked fenced area. The well was reportedly installed in the early 1950's for the disposal of x-ray waste from the Sheppard hospital. Only one interviewee was certain that the site was ever used; this interviewee reported that during the mid to late 1950's on one occasion the well was used to dispose of a quantity of material, but the volume, identity, and source of material is unknown. No written base records are available to indicate whether the site has been used.

The radioactive waste burial vault in Landfill No. 3 is in a marked area approximately 100 feet square. Interviews with base personnel failed to provide any firm details about the site. One interviewee believed that the site was activated and marked in the late 1950's or early 1960's. Another interviewee recalled from hearsay that a radioactive tool or wrench used in munitions maintenance may have been deposited in the vault on one occasion. No written base records are available to indicate whether the site has been used.

Incineration

During World War II, Sheppard AFB served as an induction center for new recruits. An incinerator was used to burn civilian clothing from the induction process and laundry wastes during this era. The incinerator was constructed near the beginning of the war and its use ended

FIGURE 4.5


SHEPPARD AFB
SUSPECTED RADIOACTIVE WASTE DISPOSAL SITES
SITE ADJACENT TO WASTE TREATMENT PLANT
SITE IN LANDFILL NO. 3
Housing Area
Housing Area
SCALE 0 1200 FEET
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

shortly after the war ended. The incinerator was located in Building 1380, presently the Entomology Shop and Environmental Support Facility. According to interviews and base records, no hazardous wastes were disposed of in the incinerator, and ash was disposed of in Landfill No. 1, which was in operation nearby during this time period. The incinerator was disassembled during the early 1970's. Because of the nature of the material burned and the length of time since termination of incinerator operation, no potential exists for contamination as a result of the incinerator and its use.

Sanitary Wastewater Treatment

A waste treatment plant was constructed at the south end of the base when the base was activated in 1941. The system has operated during all periods of base occupancy; it was extensively remodeled in 1962. The system consists of primary clarification, a high-rate and a low-rate trickling filter, secondary clarification, chlorination, anaerobic sludge digestion, and sludge drying beds. The wastewater flow to the treatment facility averages 1.0 MGD and is primarily domestic in nature. At the present time only pretreated industrial wastes are discharged to the treatment system.

No contamination episodes of note are associated with the operation of the treatment plant. On one occasion a spill of oil occurred and the oil reached the plant, but was skimmed off the clarifier and did not pass through the system. Sludge from the drying beds has been disposed of in the landfills and in other locations around the base. On several occasions in the past, dried sludge was offered to local residents, but this practice is no longer in use.

Storm Water Drainage System

The storm drainage system on Sheppard AFB consists of open ditches, concrete-lined ditches, and underground storm drainage mains. Three major underground drainage mains are in the northern section of the base. These drainage mains range in diameter from 48 to 72 inches. One major above-ground feature in the northern section of the base is the storm ponding area located west of Buildling 2320. In the southern section of the base an industrial waste line and a POL separator exist along Avenue J.

One suspected occasion of contamination in the storm drainage system did occur in 1962 when a mixture of fuel and water traveled off base via Bear Creek.

Oil-Water Separators

There are 41 oil separators, grease traps, and dump tanks in use at Sheppard AFB (see Appendix D, Table D.3). Seven of these are actual oil-water separators. Recovered oil is disposed of by an off-base contractor and the wastewaters enter the sanitary sewer system. Cleaning frequency for most separators is three months; a small number are cleaned at other intervals or upon call. Based upon the on-site survey, these units should not pose a ground-water contamination hazard due to past operations.

Pesticide Rinse Water Disposal

The rinse water generated from cleaning pesticide application equipment and empty pesticide containers has been dispersed onto a gravel lot adjacent to the Entomology Shop at Building 1380. This has been an ongoing practice as long as the shop has been at the base, which dates back to the 1940's. It is estimated that 20 gallons per month of rinse water is generated.

EVALUATION OF PAST DISPOSAL ACTIVITIES AND FACILITIES

Neither of the remote base annexes nor the municipal airport was found to have significant waste generation or disposal activities, past or present.

The review of past operation and maintenance functions and past waste management practices at Sheppard AFB has resulted in the identification of 23 sites which were initially considered as areas of concern with regard to the potential for contamination, as well as the potential for the migration of contaminants. These sites were evaluated using the Decision Tree Methodology referred to in Figure 1.1. Those sites which were considered as not having a potential for contamination were deleted from further consideration. Those sites which were considered as having a potential for the occurrence of contaminaton and migration of contaminants were further evaluated using the Hazard Assessment Rating Methodology (HARM). Table 4.3 identifies the decision tree logic used for each of the areas of initial concern.

Based on the decision tree logic, 12 of the 23 sites originally reviewed did not warrant evaluation using the Hazard Assessment Rating Methodology. The rationale for omitting these 12 sites from HARM evaluation is discussed below.

The fuel storage tanks for Fire Protection Training Area Number 3 are relatively new and are maintained in excellent repair, so only a minor potential for contamination from the tanks exists. Furthermore, spills or leaks from these tanks would flow to the oil-water separator which serves this system, so no significant potential for contaminant migration exists.

Waste storage tanks around the base are maintained in good condition and are pumped out routinely by off-base contractors, with subsequent inspection by base personnel. No instances of contamination from these tanks has been noted.

The methanol drum storage area at the northwest corner of the base is a temporary storage site for six drums of the material. The drums are inspected routinely, and are electrically grounded, and little potential for contamination exists from the short-term storage of these drums.

The surface impoundments were inspected; no contamination or evidence of potential for contamination exists for those areas.

Because of the nature of the materials stored and the methods of storage, no potential for contamination is associated with the munitions storage area.

The incinerator was operated for only a few years in the 1940's, and the materials burned were non-hazardous. Because of the nature of the materials burned and the length of time since operation, no contamination is associated with the incinerator.

The sanitary wastewater treatment system, including sludge drying and disposal, has been operated at Sheppard AFB since the early 1940's. No episodes of environmental contamination have been associated with the operations of the plant over its period of service. The sludge is non-toxic and has been used for landfarming around the base.

The storm water drainage system carries primarily rainwater off the base. All sources of significant contamination are handled by other methods.

TABLE 4.3

SUMMARY OF DECISION TREE LOGIC FOR AREAS OF INITIAL ENVIRONMENTAL CONCERN AT SHEPPARD AFB

Site	Potential for Contamination	Potential for Contaminant Migration	Potential for Other Environmental Concern	HARM Rating
FPTA-1	Y	Y	N/A	Y
FPTA-2	Y	Y	N/A	Y
FPTA-3	Y	Y	N/A	Y
FPTA Fuel Storage	Y	N	N	N
Waste Storage Tanks	Y	N	N/A	N
Methanol Drum Storage	N	N	N/A	N
Landfill No. 1	Y	Y	N/A	Y
Landfill No. 2	Y	Y	N/A	Y
Landfill No. 3 (plus hardfill)	Y	Y	N/A	Y
Waste Pits	Y	Y	N/A	Y
Industrial Waste Pit	Y	Y	N/A	Y
Surface Impoundments	N	N	N	N
Munitions Storage Area	N	N	N	N
Radioactive Site at Landfill No. 3	Y	Y	N/A	Y
Radioactive Site at WTP	Y	Y	N/A	Y
Incinerator	N	N	N	N
Sanitary Wastewater Treatment	N	N	N	N
Storm Water Drainage System	N	N	N	N
Oil-Water Separators	Y	N	N	N
Pesticide Rinse Area	Y	Y	N/A	Y
Spills and Leaks (Petroleum)	Y	N	N	N
PCB Spill	Y	N	N	N
Oil Disposed on Roadways	Y	N	N	N

The oil-water separators are pumped out regularly and inspected by base personnel. Routine maintenance is performed regularly; no contamination is associated with the oil-water separators.

The spill episodes of petroleum products were isolated instances; the spilled materials were captured while on base property and were properly disposed of. As a result of these actions, no contamination is associated with these spills.

The single confirmed episode of spilled PCB-containing dielectric was handled in an appropriate manner. All asphalt which may have been contaminated was removed for disposal by an off-base contractor. As a result, no contamination is associated with this episode.

The episodes of waste oil disposal onto unpaved roadways for fugitive dust control occurred from the late 1960's until the mid-1970's, and the oil was spread over a sizable area instead of being disposed at a single location. Oils are generally biodegradable if sufficient time is provided. Furthermore, the area soils would prevent significant migration of the oil, so no present contamination is associated with these events.

The remaining eleven sites identified on Table 4.3 were evaluated using the Hazard Assessment Rating Methodology. The HARM process takes into account characteristics of potential receptors, waste characteristics, pathways for migration, and specific characteristics of the site related to waste mangement practices. The details of the rating procedures are presented in Appendix G. Results of the assessment for the sites are summarized in Table 4.4. The HARM system is designed to indicate the relative need for follow-on action. The information presented in Table 4.4 is intended for assigning priorities for further evaluation of the Sheppard AFB disposal areas (Chapter 5, Conclusions and Chapter 6, Recommendations). The rating forms for the individual waste disposal sites at Sheppard AFB are presented in Appendix H. Photographs of some of the disposal sites are included in Appendix F.

TABLE 4.4
SUMMARY OF HARM SCORES FOR POTENTIAL
CONTAMINATION SOURCES
SHEPPARD AFB

Rank	Site	Receptor Subscore	Waste Characteristics Subscore	Pathways Subscore	Waste Management Factor	Overall Total Score
1	Waste Pits	31	80	63	1.0	58
2	Landfill No. 3	32	80	50	1.0	54
3	FPTA-3	27	80	57	0.95	52
4	FPTA-1	31	80	43	1.0	51
5	FPTA-2	21	64	50	1.0	45
6	Industrial Waste Pit	29	40	49	1.0	39
7	Landfill No. 1	31	32	50	1.0	38
8	Pesticide Spray Area	29	30	49	1.0	36
9	Low-level Radioactive Waste Disposal Site in Landfill No. 3	32	10	50	1.0	31
10	Landfill No. 2	31	8	50	1.0	30
11	Low-level Radioactive Waste Disposal Site at Waste Treatment Plant	31	10	49	0.10	3

SECTION 5

CONCLUSIONS

The goal of the IRP Phase I study is to identify sites having the potential for environmental contamination resulting from past waste disposal practices and to assess the probability of contaminant migration from these sites. The conclusions given below are based on field inspections, review of records and files, review of the environmental setting, and interviews with base personnel, past employees, and federal, state, and local government employees. Table 5.1 contains a list of the potential contamination sources identified at Sheppard AFB and a summary of the HARM scores for those sites is summarized below. The follow-on recommendations are presented in Chapter 6.

WASTE PITS

There is sufficient evidence that the Waste Pits site has potential for creating environmental contamination and a follow-on investigation is warranted. The waste pits were used primarily from 1966 until the mid-1970's for storage of waste engine cleaning solvents. The area consisted of three pits. The waste materials in the pits were removed and disposed of by an off-base contractor and the pits were closed in the mid-1970's. The three pits were of earthen construction and were unlined. The pits were in a depressed area which is subject to flooding during high rainfall events. The location of the pits was evident during the site visit.

Soils in the waste pit area have been disturbed but adjacent areas have silty loam type soils. A nearby test boring for Building 2325 encountered sandy clay (0-2.5 feet deep), clay (2.5-8.5 feet deep), and sandy clay (8.5 to 18.5 feet deep). Due to the depression, the waste pits should be in the latter sandy clay zone. These sediments have

TABLE 5.1
SITES EVALUATED USING THE
HAZARD ASSESSMENT RATING METHODOLOGY FORMS
SHEPPARD AIR FORCE BASE

Rank	Site	Operating Period	Final Harm Score
1	Waste Pits	1966 - early 1970's	58
2	Landfill No. 3 (including Hardfill)	1957 - 1972	54
3	Fire Protection Training Area No. 3	1957 - present	52
4	Fire Protection Training Area No. 1	1941 - 1957	51
5	Fire Protection Training Area No. 2	1962 - 1970	45
6	Industrial Waste Pit	1950's	39
7	Landfill No. 1	1941 - 1957	38
8	Pesticide Spray Area	1940's - present	36
9	Low-level Radioactive Waste Disposal Site in Landfill No. 3	1960's - present	31
10	Landfill No. 2	early 1960's	30
11	Low-level Radioactive Waste Disposal Site at Waste Treatment Plant	1960's - present	3

NOTE: This ranking was performed according to the Hazard Assessment Rating Methodology (HARM) described in Appendix G. Individual site rating forms are contained in Appendix H.

relatively low permeabilities. Ground water is usually present at less than ten feet below ground.

Because of the hazardous nature of the materials stored in the pits, the potential for their persistence, and the limited permeability of the area soils, a follow-on investigation is warranted. The site received a HARM score of 58.

LANDFILL NO. 3 AND HARDFILL

There is sufficient evidence that the Landfill No. 3 and Hardfill site has potential for creating environmental contamination and a follow-on investigation is warranted. The site as been used for base refuse and hardfill since the late 1950's. The landfill was a trench and fill operation. In the 1960's, waste oils were disposed of by discharge with refuse into trenches and covering with soil. The present hardfill area is adjacent to the area in which the oils were disposed, so these two areas were evaluated as one. Aerial photographs taken during the site visit indicated that settling has occurred. These depressed areas collect rainfall.

Soils in the landfill area have been disturbed, but adjacent areas have silty loam type soils. Due to the excavation and fill activities, the permeabilities in the area could be highly variable, but a subsurface base of clay is evident from nearby test borings. Ground water is usually present at less than ten feet below ground.

Because of the deposition of oils in the fill area, a follow-on investigation is warranted. This site received a HARM score of 54.

FIRE PROTECTION TRAINING AREA NO. 3

There is sufficient evidence that FPTA-3 has potential for creating environmental contamination and a follow-on investigation is warranted. FPTA-3 has been in operation since approximately 1957; contaminated fuel has been the primary material used for fire training exercises. Until 1982 no waste fuel drainage, collection, and separation system was in operation at the site. The soil at the site is discolored, and a strong odor of fuel permeates the area. Natural soils in this area are composed of silty loam with relatively low permeabilities. A nearby test

boring at Building 2013 encountered clay from 0 to 15 feet below ground. Ground water is usually present at less than ten feet below ground.

The deposition of fuel onto a ground area without long-term use of adequate underdrains and separators warrants a follow-on investigation of this site. This site received a HARM score of 52.

FIRE PROTECTION TRAINING AREA NO. 1

There is sufficient evidence that site FPTA-1 has potential for creating environmental contamination and a follow-on investigation is warranted. FPTA-1 was activated in the early 1940's and was used for fire training exercises until the site was closed for construction of the base golf course in the late 1950's. During its period of service, significant quantities of contaminated waste oils, fuels, solvents, and other combustible chemicals were used for fire protection training exercises. No drainage, collection, and reclaimed fuel storage facilities were present at the site. The soils in the surrounding area have been disturbed by the excavation and fill activities related to Landfill No. 1. Present soil classifications indicate that undisturbed soils are composed of silty loam with relatively low permeabilities. Ground water is usually present at less than ten feet below ground.

The deposition of fuel onto a ground area without a drainage and collection system warrants a follow-on investigation. The site received a HARM score of 51.

FIRE PROTECTION TRAINING AREA NO. 2

There is not sufficient evidence that site FPTA-2 has potential for creating environmental contamination and a follow-on investigation is not warranted. The FPTA-2 area was used by the Local Base Rescue (LBR) unit for fire training exercises from about 1968 until 1976. The surface soils in the surrounding area have been disturbed for construction of the runways. Adjacent soils are composed of silty loam with relatively low permeabilities. This site received a HARM score of 45.

SECTION 6

RECOMMENDATIONS

Eleven sites were identified at Sheppard AFB as having the potential for environmental contamination and have been evaluated using the HARM system. This evaluation assessed their relative potential for environmental contamination and identified those sites where further study and monitoring may be necessary. Of primary concern are those sites with a sufficient evidence of environmental contamination that should be investigated in Phase II. All sites have been reviewed with regard to future land use restrictions which may be applicable due to the nature of each site.

PHASE II MONITORING RECOMMENDATIONS

The following recommendations are made to further assess the potential for environmental contamination from waste disposal areas at Sheppard AFB. The recommended actions are generally one-time sampling programs to determine if contamination does exist at the site. If contamination is identified, the sampling program may need to be expanded to further define the extent of contamination. Geophysical surveys, consisting of electrical resistivity, electromagnetic and/or magnetometer techniques, are recommended prior to the well installations to attempt to delineate the horizontal and vertical extent of the site as well as any subsurface leachate plumes migrating from the site. Preliminary checks with one or more geophysical techniques on and in the vicinity of the site should be made to determine the effectiveness of a particular geophysical technique prior to a complete site survey. Following the geophysical surveys the proper placement of ground-water monitoring wells can be determined. During the installation of the wells, readings with an organic vapor analyzer or similar equipment should be made. In addition, explosimeter readings (methane detection) should be made while drilling near the landfills. The ground water at those sites with a

potential for environmental contamination will be monitored with wells consisting of Schedule 40 PVC screens and casing with threaded joints. Screens will be placed into the water-table aquifer (less than 30 feet deep). Investigators have found rigid PVC casing with threaded joints to be very acceptable as ground water monitoring wells for similar situations (Curran and Tomson, 1983). If the initial samples indicate contamination, additional wells may be required. The number of wells may be reduced if the geophysical techniques are successful in identifying subsurface leachate plumes. An additional reduction in the number of wells can be accomplished by strategically locating the wells in areas where they may serve as upgradient or downgradient well points for more than one site. The recommended monitoring program for Phase II is summarized in Table 6.1.

1. The Waste Pits have a potential for environmental contamination and monitoring of these pits is recommended. Prior to installation of ground-water monitoring wells, surface geophysical techniques such as electrical resistivity and/or electromagnetic surveys should be employed. Electrical resistivity should be more applicable than electromagnetics at this site due to the depth of investigation. The surveys, if effective, should be used to guide the placement of one upgradient and two downgradient wells to characterize the ground-water quality and identify any contaminant migration. Samples from the wells from Bear Creek (upstream and immediately downstream of the pits) and from sediment in the pits should be analyzed for the parameters listed in Table 6.2, list A.
2. Landfill No. 3 and the Hardfill Area have a potential for environmental contamination and monitoring of these sites is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electrical resistivity, electromagnetic and magnetometer surveys should be employed. Electrical resistivity should be effective for determining the landfill depth and general stratigraphy underlying the landfill. Electromagnetics Table 6.1 should be effective

TABLE 6.1
RECOMMENDED MONITORING PROGRAM FOR PHASE II
SHEPPARD AFB

Ranking Number	Site Name	Rating Score	Recommended Monitoring	Sample Analyses List[1]	Comments
1	Waste Pits	58	Conduct geophysical surveys (resistivity); install and sample 1 upgradient and 2 downgradient wells; sample Bear Creek and pit sediment.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
2	Landfill No. 3 and Hardfill	54	Conduct geophysical surveys (resistivity, electromagnetics and magnetometer); install and sample 1 upgradient and 3 downgradient wells; sample stream flowing through site.	B	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
3	Fire Protection Training Area No. 3	52	Conduct geophysical surveys (electromagnetics); install and sample 1 upgradient and 2 downgradient wells; sample existing pond.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.
4	Fire Protection Training Area No. 1	51	Conduct geophysical surveys (electromagnetics); if survey indicates contamination, install and sample 1 upgradient and 3 downgradient wells; sample adjacent streams and ponds.	A	Continue monitoring if sampling indicates contamination. Additional wells may be necessary to assess extent of contamination.

Notes: 1. See Table 6.2 for lists and individual parameters within each list.

TABLE 6.2
RECOMMENDED LIST OF ANALYTICAL PARAMETERS
SHEPPARD AFB

LIST A

pH
Total Dissolved Solids
Oil and Grease
Total Organic Carbon
Volatile Aromatics
Total Organic Halogens
Phenolics

LIST B

pH
Total Dissolved Solids
Oil and Grease
Total Organic Carbon
Lead
Chromium
Mercury
Volatile Aromatics
Total Organic Halogens

for determining the locations of shallow trenches and the locations of the hardfill. Magnetometer surveys should be effective in determining the locations of ferro-magnetic material in the landfill. The surveys, if effective, should be used to guide the placement of one upgradient and three downgradient wells to characterize the ground-water quality and identify any contaminant migration. Samples from the wells and the stream flowing through the site (upstream and downstream) should be analyzed for the parameters listed in Table 6.2, list B. Metals parameters are shown in list B because of the potential for disposal of metals-containing paints and other materials from which metals contamination may occur.

3. Fire Protection Training Area No. 3 has a potential for environmental contamination and monitoring of the site is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electromagnetic surveys should be employed. Electromagnetics should be effective in determining the location of possible ground-water contamination plumes. The surveys, if effective, should be used to guide the placement of one upgradient and two downgradient wells to characterize the ground-water quality and identify any contaminant migration. Samples from the wells and the pond at the site should be analyzed for the parameters listed in Table 6.2, list A.

4. Fire Protection Training Area No. 1 has a potential for environmental contamination and monitoring of the site is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electromagnetic surveys should be employed. Electromagnetics should be effective in determining the location of possible ground-water contamination plumes. If the surveys indicate ground-water contamination, one upgradient and three downgradient wells should be installed to characterize the ground-water quality and identify any contaminant migration. Samples from the wells and immediately adjacent surface-water bodies (streams and golf course ponds) should be analyzed for the parameters listed in Table 6.2, list A.

5. Fire Protection Training Aea No. 2 has a potential for environmental contamination and monitoring of the site is recommended. Prior to the installation of ground-water monitoring wells, surface geophysical techniques such as electromagnetic surveys should be employed. Electromagnetics should be effective in determining the location of possible ground-water contamination plumes. If the surveys indicate ground-water contamination, one upgradient and three downgradient wells should be installed to characterize the ground-water quality and identify any contaminant migration. Samples from the wells should be analyzed for the parameters listed in Table 6.2, list A.

The sites recommended for environmental monitoring are shown in Figure 6.1.

RECOMMENDED GUIDELINES FOR LAND USE RESTRICTIONS

It is desirable to have land use restrictions for the following reasons: (1) to provide the continued protection of human health, welfare, and the environment; (2) to insure that the migration of potential contaminants is not promoted through improper land uses; (3) to facilitate the compatible development of future USAF facilities; and (4) to allow for identification of property which may be proposed for excess or outlease.

The recommended guidelines for land use restrictions at each of the identified disposal and spill sites at Sheppard AFB are presented in Table 6.3. A description of the land use restriction guidelines is presented in Table 6.4. Land use restrictions at sites recommended for Phase II monitoring should be reevaluated upon the completion of the Phase II monitoring program and changes made where appropriate.

FIGURE 6.1

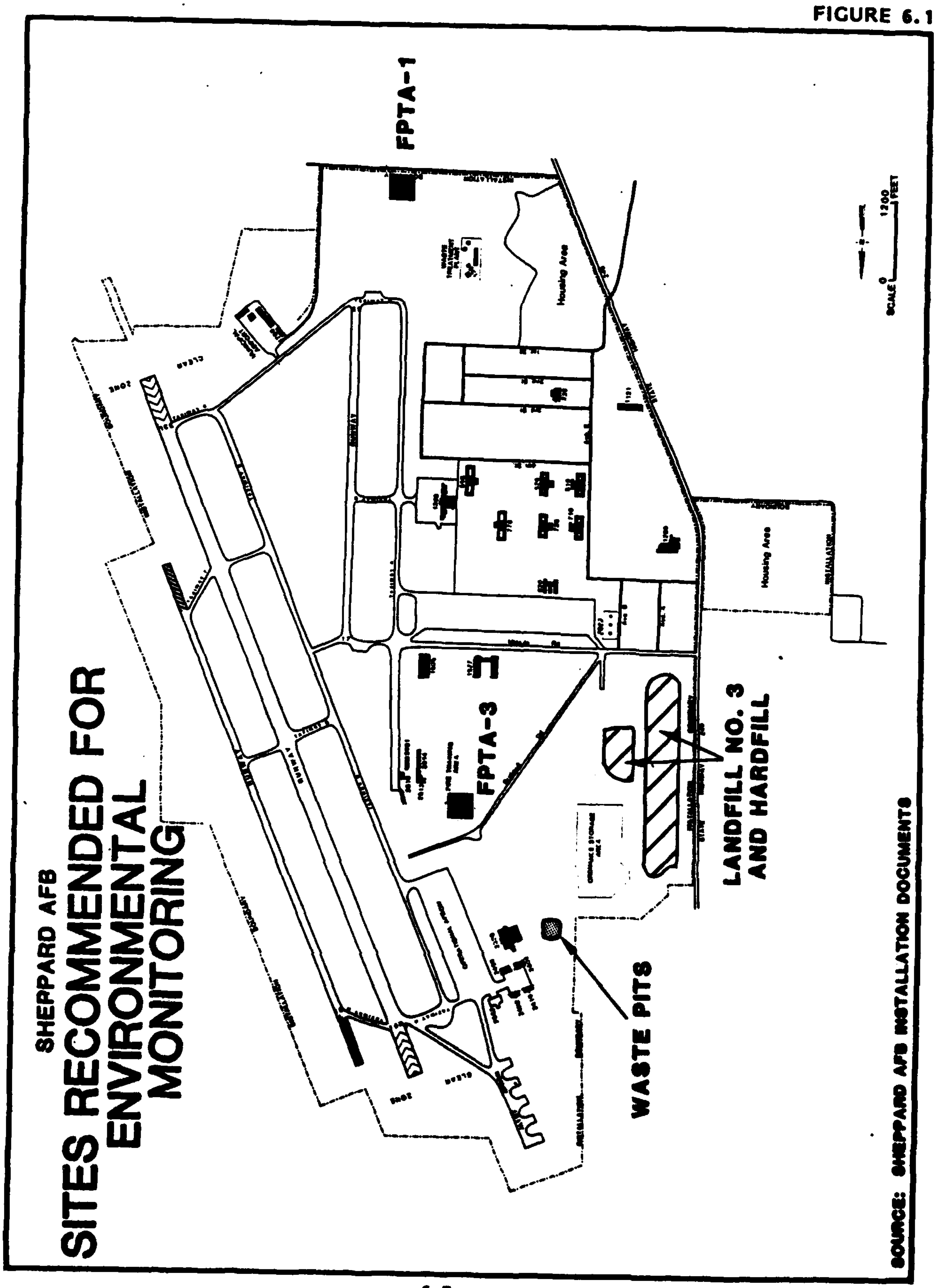

SHEPPARD AFB
SITES RECOMMENDED FOR ENVIRONMENTAL MONITORING
FPTA-1
FPTA-3
LANDFILL NO. 3 AND HARDFILL
WASTE PITS
Housing Area
Housing Area
SCALE 0 1200 FEET
SOURCE: SHEPPARD AFB INSTALLATION DOCUMENTS

TABLE 6.3
RECOMMENDED GUIDELINES FOR FUTURE LAND USE RESTRICTIONS
SHEPPARD AFB

Site Name	Construction	Excavation	Wells	Agriculture	Silvi-culture	Water Infiltration	Recreation	Burning	Disposal Operations	Vehicular Traffic	Material Storage	Housing
Waste Pits	R	R	R	R	R	R	R	R	R	R	R	R
Landfill No. 3	R	R	R	R	R	R	R	R	R	R	R	R
FPTA No. 3	R	R	R	R	R	R	R	PU	R	R	PU	R
FPTA No. 1	R	R	R	R	R	R	PU	R	R	R	R	R
FPTA No. 2	NA	R	R	R	R	R	NA	R	R	R	R	NA
Industrial Waste Pit	R	R	R	NA	R	R	R	R	R	R	R	R
Landfill No. 1	R	R	R	R	R	R	PU	R	R	R	R	R
Pesticide Spray Area	NR	R	R	NA	R	R	NA	R	R	PU	R	R
Low-Level Radio-active Waste Disposal Site in Landfill No. 3	R	R	R	R	R	R	R	R	R	R	R	R
Landfill No. 2	R	R	R	R	R	R	R	R	R	R	R	R
Low-Level Radio-active Waste Disposal Site at Waste Treat-ment Plant	R	R	R	R	R	R	R	R	R	R	R	R

Notes: FPTA = Fire Protection Training Area
NA = Not Applicable
NR = No Restriction
PU = Present Use
R = Restriction

TABLE 6.4
DESCRIPTION OF GUIDELINES FOR LAND-USE RESTRICTIONS

Guideline	Description
Construction on the site	Restrict the construction of structures which make permanent (or semi-permanent) and exclusive use of a portion of the site's surface.
Excavation	Restrict the disturbance of the cover or subsurface materials.
Well construction on or near the site	Restrict the placement of any wells (except for monitoring purposes) on or within a reasonably safe distance of the site. This distance will vary from site to site, based on prevailing soil conditions and ground-water flow.
Agricultural use	Restrict the use of the site for agricultural purposes to prevent food chain contamination.
Silvicultural use	Restrict the use of the site for silvicultural uses (root structures could disturb cover or subsurface materials).
Water infiltration	Restrict water run-on, ponding and/or irrigation of the site. Water infiltration could produce contaminated leachate.
Recreational use	Restrict the use of the site for recreational purposes.
Burning or ignition sources	Restrict any and all unnecessary sources of ignition, due to the possible presence of flammable compounds.
Disposal operations	Restrict the use of the site for waste disposal operations, whether above or below ground.
Vehicular traffic	Restrict the passage of unnecessary vehicular traffic on the site due to the presence of explosive material(s) and/or of an unstable surface.
Material storage	Restrict the storage of any and all liquid or solid materials on the site.
Housing on or near the site	Restrict the use of housing structures on or within a reasonably safe distance of the site.

APPENDICES
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APPENDIX A

BIOGRAPHICAL DATA

H. D. Harman, P.G.
E. H. Snider, Ph.D., P.E., Project Manager
M. I. Spiegel

Biographical Data

H. DAN HARMAN, JR.
Hydrogeologist

PII Redacted [redacted]

Education

B.S., Geology, 1970, University of Tennessee, Knoxville, TN

Professional Affiliations

Registered Professional Geologist (Georgia NO.569)
National Water Well Association (Certified Water Well Driller No. 2664)
Georgia Ground-Water Association

Experience Record

1975-1977 Northwest Florida Water Management District, Havana, Florida. Hydrogeologist. Responsible for borehole geophysical logger operation and log interpretation. Also reviewed permit applications for new water wells.

1977-1978 Dixie Well Boring Company, Inc., LaGrange, Georgia. Hydrogeologist/Well Driller. Responsible for borehole geophysical logger operation and log interpretation. Also conducted earth resistivity surveys in Georgia and Alabama Piedmont Provinces for locations of water-bearing fractures. Additional responsibilities included drilling with mud and air rotary drilling rigs as well as bucket auger rigs.

1978-1980 Law Engineering Testing Company, Inc., Marietta, Georgia. Hydrogeologist. Responsible for ground-water resource evaluations and hydrogeological field operations for government and industrial clients. A major responsibility was as the Mississippi Field Hydrologist during the installation of both fresh and saline water wells for a regional aquifer evaluation related to the possible storage of high level radio-active waste in the Gulf Coast Salt Domes.

1980-1982 Ecology and Environment, Inc., Decatur, Georgia. Hydrogeologist. Responsible for project management of hydrogeological and geophysical investigations at uncontrolled hazardous waste sites. Also prepared Emergency Action Plans and Remedial Approach Plans for U.S. Environmental Protection Agency. Additional

responsibilities included use of the MITRE hazardous ranking system to rank sites on the National Superfund List.

1982-1983 NUS Corporation, Tucker, Georgia. Hydrogeologist. Responsible for project management of hydrogeological and geophysical investigations at uncontrolled hazardous waste sites.

1983-Date Engineering-Science, Inc., Atlanta, Georgia. Hydrogeologist. Responsible for hydrogeological as well as geophysical evaluations at hazardous waste sites.

Publications and Presentations

"Geophysical Well Logging: An Aid in Georgia Ground-Water Projects," 1977, coauthor: D. Watson, The Georgia Operator, Georgia Water and Pollution Control Association.

"Use of Surface Geophysical Methods Prior to Monitor Well Drilling," 1981. Presented to Fifth Southeastern Ground-Water Conference, Americus, Georgia.

"Cost-Effective Preliminary Leachate Monitoring at an Uncontrolled Hazardous Waste Site," 1982, coauthor: S. Hitchcock. Presented to Third National Conference on Management of Uncontrolled Hazardous Waste Sites, Washington, D.C.

"Application of Geophysical Techniques as a Site Screening Procedure at Hazardous Waste Sites," 1983, coauthor: S. Hitchcock. Proceedings of the Third National Symposion and Exposition on Aquifer Restoration and Ground-Water Monitoring, Columbus, Ohio.

BIOGRAPHICAL DATA

Eric Heinman Snider

Senior Chemical Engineer

PII Redacted [redacted]

Education

B.S. in Chemistry (Magna Cum Laude), 1973, Clemson University, Clemson, S.C.
M.S. in Chemical Engineering, 1975, Clemson University, Clemson, S.
Ph.D. in Chemical Engineering, 1978, Clemson University, Clemson, S.C.

Professional Affiliations

Registered Professional Engineer (Oklahoma Number 13499)
American Institute of Chemical Engineers
American Chemical Society
American Society for Engineering Education
Certified Professional Chemist, A.I.C. (1975)

Honorary Affiliations

Sigma Xi
Tau Beta Pi
Phi Kappa Phi
Who's Who in the South and Southwest, 1981
Outstanding Young Men of America, 1983

Experience Record

1971-1975 Texidyne, Inc., Clemson, S.C., Staff Chemist. Responsible for routine and specialized chemical analyses for water, wastewater, solid wastes, and air pollution testing. Experience in gas chromatography, atomic absorption, microbiological testing.

1975-1978 Texidyne, Inc., Clemson, S.C., Part-time Consultant. Responsible for overall management of laboratory facilities and some wastewater engineering studies. Also ran incinerator performance studies.

Eric H. Snider (Continued)

1976-1977 Clemson University, Clemson, S.C., Chief Analyst on airborne fluoride monitoring project in Chemical Engineering Department, performed for Owen-Corning Fiberglas Corp., Toledo, Ohio.

1978-1982 The University of Tulsa, Tulsa, OK., Assistant Professor of Chemical Engineering and Associate Director, University of Tulsa Environmental Protection Projects (UTEPP) Program. Normal teaching duties; research centered on specialized petroleum refinery problems of water and solid wastes.

1982-1983 The University of Tulsa, Tulsa, OK., Associate Professor of Chemical Engineering and Director of UTEPP Program. Normal teaching duties; researched and wrote five monographs on environmental areas; including, incineration, flotation, gravity separation, screening/sedimentation, and equalization.

1983-Date Engineering-Science, Senior Engineer. Responsible for a wide variety of waste treatment, chemical process, resource recovery, energy, incineration and air pollution control activities for industrial, governmental and local municipal clients. Recent activities include incineration evaluation for a toxic chemical disposal facility to be operated by the U.S. Army on Johnston Atoll, investigation of the breaking of oil/water emulsions from an industrial process discharge, analytical verification of oil residues in contaminated ground water at a hazardous waste disposal site and evaluation of alternative treatment technologies for a new pharmaceutical production facility including vapor re-compression evaporation, incineration, biological oxidation and various air pollution control systems. Particularly strong technical areas include waste treatment chemistry, incineration, analytical troubleshooting, R&D and resource recovery technologies including energy recovery.

Publications

Snider, E.H., and J.J. Porter: Ozone Destruction of Selected Dyes in Wastewater, Am Dyestuff Rep., 63 (8), 36-48, 1974.

Porter, J.J., and E.H. Snider: Thirty Day Biodegradability of Textile Chemicals and Dyes, Book of Papers of 1974 National Technical Conference of AATCC, 427-436 (1974).

Snider, E.H., and J.J. Porter: Ozone Treatment of Dye Waste, J. Water Pollut. Control Fed., 46, 886-894, 1974.

Eric H. Snider (Continued)

Porter, J.J., and E.H. Snider: Long Term Biodegradability of Textile Chemicals, J. Water Pollut. Control Fed., 48, 2198-2210, 1976.

Snider, E.H., and J.J. Porter: Comparison of Atmospheric Hydrocarbon Levels with Air Quality Standards, Am. Dyestuff Ref., 65 (8), 22-31, 1976.

Snider, E.H.: Organization of a Functional Chemical Engineering Library; Chem. Eng. Ed., 11 (1), 44-48, 1977.

Snider, E.H., and F.C. Alley: Kinetics of the Chlorination of Biphenyl Under Conditions of Waste Treatment Processes, Env. Sci. Tech., 13, 1244-1248 (1979).

Snider, E.H. and F.C. Alley: Kinetics of Biphenyl Chlorination in Aqueous Systems in the Neutral and Alkaline pH Ranges, Chapter 21 in Proceedings Third Conference on Chlorination, Ann Arbor Science Publishers, Inc., Ann Arbor, MI, 1980.

Sublette, K.L., E.H. Snider, and N.D. Sylvester: Powdered Activated Carbon Enhancement of the Activated Sludge Process: A Study of the Mechanisms, in Proceedings of the Eighth Annual Water and Wastewater Equipment Manufacturers Association (WWEMA) Industrial Pollution Conference, pp. 351-369, 1980.

Snider, E.H.: "Chemical Engineering Laboratory Courses at The University of Tulsa: Improving the Communication of Technical Results," in Proceedings of the Fifteenth Midwest Section Conference of ASEE, pp. IIB28-IIB35, 1980.

Snider, E.H.: "Chemical Engineering Laboratory Experiment: Mass Transfer Tray Hydraulics," in Proceedings of 16th Midwest Section Conference of ASEE, pp. II A-9 - II A-16, 1981.

Snider, E.H.: "Chemical Engineering Laboratory Experiment: Mass Transfer Tray Hydraulics," in Proceedings of 1981 ASEE National Meeting, Vol. II, pp. 360-363, 1981.

Snider, E.H. and F.S. Manning: "A Survey of Pollutant Emission Levels in Wastewaters and Residuals from the Petroleum Refining Industry," Env. International, Vol. 7, pp. 237-258, 1982.

Sublette, K.L., E.H. Snider and N.D. Sylvester: "A Review of the Mechanism of Powdered Activated Carbon Enhancement of Activated Sludge Treatment," Water Research, 16, 1075-1082 (1982).

Books; Monographs; Chapters

Manning, F.S., and E.H. Snider; "Equalization," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Ford, D.L., F.S. Manning, and E.H. Snider: "Flotation," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Eric H. Snider (Continued)

Manning, F.S., and E.H. Snider; "Oil and Grease Removal by Gravity," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Manning, F.S., and E.H. Snider; "Incineration: Wastewater Treatment Applications," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Manning, F.S., E.H. Snider, and E.L. Thackston: "Screening and Sedimentation," Invited Monograph in Series on Wastewater Treatment Technology, W.W. Eckenfelder and J.W. Patterson, ed., 1981.

Short Courses and Presentations

January 1974	Presentation of paper, "Comparison of Existing Air Pollution Levels with Standards," Third Annual Conference on Textile Wastewater and Air Pollution Control, Hilton Head Island, S.C.
May 1974	Presentation of paper, "Thirty Day Biodegradability of Textile Chemicals and Dyes," 1974 Annual Technical Conference of American Association of Textile Chemists and Colorists, New Orleans, LA.
June 1977	Presentation, "Air Pollution Instrumentation"; Short Course on Industrial Pollution Control, Clemson University, Clemson, S.C.
June 1977	Presentation, "Industrial Sludge Treatment and Disposal"; Short Course on Industrial Pollution Control, Clemson University, Clemson, S.C.
October 1977	Presentation, "A Kinetic Study of the Reactions of Biphenyl and Chlorine in Water to Form Chlorobiphenyls"; Chem. Eng. Dept. seminar, Clemson University, Clemson, S.C.
January 1978	Presentation of paper, "Carbon Adsorption for Removal of Gaseous Pollutants," 1978 Technical Meeting of American Association of Textile Chemists and Colorists, New York, N.Y.
January 1978	Presentation of paper, "Carbon Adsorption for Removal of Gaseous Pollutants," The University of Tulsa, Tulsa, OK.
June 1980	Presentation of paper, "Powdered Activated Carbon Enhancement of the Activated Sludge Process," Eighth Annual Meeting of the Water and Wastewater Treatment Manufacturers Association, Austin, TX.

Eric H. Snider (Continued)

June 1981	Presentation of paper, "The Valve Tray Column: An Experiment in Tray Hydraulics," Annual National Meeting of Am. Soc. for Engr. Education, Los Angeles, CA.
March 1982	Presentation of paper, "PAC Enhancement of the Activated Sludge Process," Chem. Engr. Dept. seminar series, University of Oklahoma, Norman, OK.

Biographical Data

MARK I. SPIEGEL

Environmental Scientist

PII Redacted [redacted]

Education

B.S. in Environmental Health Science (Magna cum laude), 1976, University of Georgia, Athens, Georgia
Limnology and Environmental Biology, University of Florida, Gainesville, Florida
MBA 1983, Marketing, Georgia State University

Professional Affiliations

American Water Resources Association
Technical Association of the Pulp and Paper Industry

Experience Record

1974-1976 U.S. Environmental Protection Agency, Surveillance and Analysis Division. Cooperative Student. On assignment to Air Surveillance Branch, participated in ambient air study in Natchez, Mississippi, and operated unleaded fuel sampling program for Southeast National Air Surveillance Network. For Engineering Branch, participated in NPDES compliance monitoring of industrial facilities throughout the southeast; operation and maintenance studies of municipal waste treatment facilities; and post-impoundment study of West Point Reservoir, West Point, Georgia. Participated in industrial bioassay studies for the Ecological Branch.

1977-Date Engineering-Science. Environmental Scientist. Responsible for the conduct of water and wastewater sampling programs and analyses, quality control, laboratory process evaluations, and evaluation of other environmental assessment data. Conducted leachate extraction studies of sludges produced at a large organic chemicals plant to define nature of sludges according to the Resource Recovery and Conservation Act Guidelines. Involved in laboratory quality assurance program for the analysis of water samples used in a stream modeling project. Conducted a water quality modeling study for Amerada Hess Corporation to determine the assimilative capacity of

Mark I. Spiegel (Continued)

a stream receiving effluent from a southern Mississippi refinery.

Participated in bench-scale industrial treatability studies conducted for the American Textile Manufacturers Institute and Eli Lilly Pharmaceuticals in Mayaguez, Puerto Rico, and in carbon adsorption studies for an American Cyanamid chemical plant and Union Carbide Agricultural Products Division.

Involved in various aspects of several industrial environmental impact assessments including preliminary planning for a comprehensive study for St. Regis Paper Company on a major pulp and paper mill expansion project. Assisted in preparation of third-party EIS for EPA and Mobil Chemical Company concerning a proposed 16,000-acre phosphate mining and beneficiation facility. Developed an EIA prior to construction of a pulp and paper complex by the Weyerhaeuser Company in Columbus, Mississippi, which included preparation of a separate document for the Interstate Commerce Commission concerning the construction of a railroad spur to serve the complex. Also involved in formulating the water quality, water resource and socio-economic aspects of an environmental impact assessment for International Paper Company. Participated in large scale site evaluation to determine the suitability and environmental permitting requirements of a site for an east coast brewery for the Adolph Coors Company. Participated in a study to evaluate various options for developing a large parcel of land in the coastal section of North Carolina. The study involved evaluating both the market potential and environmental constraints of various options for development such as timber harvesting, peat mining, corporate farming and aquaculture.

Project Manager. Conducted comprehensive process evaluation of an 80 mgd wastewater treatment system for Weyerhaeuser Company. Responsible for a study to determine the leaching characteristics of sludges for a paint manufacturing facility for RCRA compliance. Also managed study for development of a solid waste management plan for a ceramic pottery manufacturer in northern Alabama which included evaluating surface and ground-water contamination potential from the existing disposal site and assisting manufacturer in developing a disposal program acceptable to state agencies.

Mark I. Spiegel (Continued)

Participated as project team member for Phase I Installation Restoration Program projects for the Department of Defense. Studies were conducted at twelve Air Force bases to identify past hazardous waste disposal practices that could result in migration of contaminants and to recommend priority sites requiring further investigation.

Developed an Environmental Audit Manual for a pharmaceutical company. The purpose of the audit manual was to aid the company in identifying areas where a particular facility may not comply with Federal and state environmental regulations.

APPENDIX B
LIST OF INTERVIEWEES

TABLE B.1
LIST OF INTERVIEWEES

Position	Years of Service
1. NCOIC, Supply Squadron	3
2. Civilian, Assistant to Chief of Supply	27
3. Civilian Foreman, Grounds	18
4. Civilian, Heavy Equipment Operator, Pavement and Grounds	39
5. Civilian Operator, Environmental Support	20
6. Civilian Operator, Environmental Support	17
7. Civilian Supervisor, Grounds	27
8. Assistant NCOIC, Deputy Fire Chief	2
9. Civilian, Lead Fire Fighter	23
10. Civilian Supervisor, Fire Department	24
11. Civilian, Chief of DPDO	25
12. Civilian, Center Historian	2
13. NCOIC, Environmental Support	2
14. Civilian Foreman, Environmental Support	21
15. Civilian, Environmental Planner	31
16. NCOIC, Pavement and Equipment	2
17. Civilian, Welding Shop	21
18. NCOIC, Operations	1
19. Assistant NCOIC, Operations	14
20. NCOIC, Sanitation	1
21. Civilian, Chief of Real Property	29
22. Civilian, Welding Shop Supervisor	32
23. Civilian, Grounds	12
24. NCOIC, Department of Dentistry	2
25. NCOIC, Department of Radiology	6
26. NCOIC, Dental Clinic	1
27. NCOIC, Radiology Services	2
28. NCOIC, Radioisotope Laboratory	1
29. NCOIC, Clinical Laboratory	3
30. NCOIC, Operating Room	11
31. OIC, Veterinary Clinic	2
32. Civilian Supervisor, Training Services/ Audiovisual Division	23
33. NCOIC, Missile Branch, 3750 TCHTG	5
34. NCOIC, Aircraft Maintenance Branch, 3750 TCHTG	3
35. NCOIC Helicopter Course, 3750 TCHTG	3
36. NCOIC Corrosion Control Course, 3750 TCHTG	15
37. NCOIC Entomology Course, 3750 TCHTG	5
38. NCOIC Site Development Course, 3750 TCHTG	1
39. Civilian Supervisor, Corrosion Control, 3750 CMS	20

TABLE B.1
(Continued)
LIST OF INTERVIEWEES

Position	Years of Service
40. NCOIC PMEL, 3750 CMS	2
41. NCOIC Battery Shop, 3750 CMS	3
42. NCOIC Pneudraulics Shop, 3750 CMS	3
43. NCOIC Aircraft Trainer Maintenance, 3750 CMS	1
44. NCOIC 2054 Communications Squadron	4
45. Civilian Supervisor, 3750 Transportation Division	6
46. Civilian Supervisor, 3750 Transportation Division	22
47. NCOIC Printing Plant, 3750 ABG	3
48. Civilian Asst. Manager, Auto Hobby Shop, 3750 ABG	17
49. Civilian Foreman, BX Service Station	2
50. Civilian Assistant Supervisor, Golf Course Maintenance, 3750 CES	7
51. Civilian Supervisor, Entomology Shop, 3750 CES	11
52. NCOIC Power Production Shop, 3750 CES	2
53. NCOIC Exterior Electrics, 3750 CES	2
54. Civilian Foreman Field Maintenance Branch, Northrup Contractor	16
55. OIC Bioenvironmental Engineering	3
56. Bioenvironmental Engineer	10
57. Civilian Assistant Fuels Officer/Superintendent, Fuels Management Branch	18
58. Civilian Secretary, Fuels Management Branch	21
59. Civilian Superintendent, Fuels Management Branch	28
60. Civilian Fuels Systems Operator, Fuels Management Branch	31

TABLE B.2
LIST OF OUTSIDE AGENCIES

1. Ed Sprole, Manager
Water Supply and Wastewater
Treatment Facilities
City of Burkburnett
Water Department
Burkburnett, TX
(817) 569-0761

2. Subir Mukerjee, Planner III
City of Wichita Falls
Planning
Wichita Falls, TX
(817) 322-5611

3. Richard R. Manahan, Assistant
Director
City of Wichita Falls
Public Utilities
Wichita Falls, TX
(817) 322-5611

4. Publications Clerk
National Oceanic and
Atmospheric Administration
National Climatic Data Center
Asheville, NC
(704) 259-0682

5. Tom Merritt, Planner
Nortex Regional Planning
Commission
Wichita Falls, TX
(817) 322-5281

6. Jay Heidecker, Records Clerk
Petroleum Information
Corporation
Wichita Falls, TX
(817) 322-4451

7. Fred Parkey, Director
Red River Authority of Texas
Wichita Falls, TX
(817) 723-8697

8. Publications Clerk
Texas Bureau of Economic
Geology
Austin, TX
(512) 471-1534

9. L. B. Griffith, Jr., Engineer
Texas Department of Health
Division of Solid Waste
Management
Austin, TX
(512) 458-7111

10. Dan Mueller, Geologist
Texas Department of Water
Resources
Austin, TX
(512) 475-3606

11. Burni Baker, Geologist
Texas Department of Water
Resources
Austin, TX
(512) 475-3606

12. Barri Kyle, Hydrologist
Texas Department of Water
Resources
Austin, TX
(512) 475-3681

13. Paula Thetford, Field
Representative
Texas Department of Water
Resources
Duncanville, TX
(214) 298-6171

14. Secretary
Texas Parks and Wildlife
Department
Wichita Falls, TX
(817) 723-7327

15. William Stroman, Civil
Engineer Specialist in
Expansive Soils
U.S. Army Corps of Engineers
Geotechnical Branch
Ft. Worth, TX
(817) 334-2150

TABLE B.2
(Continued)
LIST OF OUTSIDE AGENCIES

16. Michael A. Isbell, Soil Scientist
U.S. Department of Agriculture
Soil Conservation Service
Iowa Park, TX
(817) 592-4176

17. Patrick Conner, Soil Scientist
U.S. Department of Agri-culture
Soil Conservation Service
Sherman, TX
(214) 892-6013

18. Doug Bartosh, Soil Scientist
U.S. Department of Agriculture
Soil Conservation Service
Temple, TX
(817) 774-1255

19. Mark Mapston, Wildlife Damage Control Specialist
U.S. Department of Interior, Fish and Wildlife Service
Wichita Falls, TX

20. James Highland, Federal Facilities Coordinator
U.S. Environmental Protection Agency, Region VI
Dallas, TX
(214) 767-9930

21. Jerry Land, Geologist
U.S. Geological Survey
Water Resources Division
Austin, TX
(512) 482-5766

22. Chuck Tidwell, Hydrologist
U.S. Geological Survey
Water Resources Division
Wichita Falls, TX
(817) 766-4052

23. Doris Tipps, Hydraulic Technician
U.S. Geological Survey
Water Resources Division
Wichita Falls, TX
(817) 766-4052

24. Jimmy Banks, General Manager
Wichita County Water Improvement District No. 2
Wichita Falls, TX
(817) 767-6721

25. Coolidge Threadgill, Director
Wichita Falls City - Wichita County
Public Health Center
Air and Water Pollution
Wichita Falls, TX
(817) 322-9702

APPENDIX C
TENANT MISSIONS

APPENDIX C

TENANT ORGANIZATIONS AND MISSIONS

The following is a listing of the major tenant organizations stationed at Sheppard Air Force Base, along with a description of their missions.

80th Flying Training Wing

The mission of the 80th Flying Training Wing is to conduct pilot training in T-37 and T-38 aircraft.

Air Force Audit Agency Office

The primary duty of the office is to provide all levels of Air Force management with an independent, objective, and constructive evaluation of the effectiveness and efficiency with which managerial responsibilities are carried out.

2054th Communications Squadron

The 2054th Communications Squadron provides air traffic control for the Wichita Falls/Sheppard AFB area, provides base communications, directs communications - electronics maintenance, and shares responsibility for maintaining intercontinental communications.

3314th Management Engineering Squadron, Detachment 5

The mission of this unit is to direct, develop, and operate the USAF Manpower/Management Engineering Program at Sheppard. The unit performs manpower utilization surveys, organizational analyses, manpower determinant studies, and management advisory studies.

24th Weather Squadron, Detachment 12

The primary duty of this unit is to provide weather service to all units at Sheppard AFB.

APPENDIX D

SUPPLEMENTAL BASE ENVIRONMENTAL DATA

TABLE D.1

ENTOMOLOGY CHEMICALS USED NOVEMBER 1976 - SEPTEMBER 1983
SHEPPARD AFB

1. Pyrethrum	16. Lindane
2. Malathian	17. DDVP
3. Diazinon	18. Rodenticide
4. Chlordane	19. Arsen/Organic
5. Baygon	20. Ficam W
6. Anticoagulant	21. Dursban
7. Fungicide	22. Resmethrin
8. Dalapon	23. Di-Systan
9. 2-4-D	24. Dipel
10. Bromacil	25. Dylox
11. Sevin	26. Kelthane
12. Dibrom	27. D-Phonethrin
13. Monuron	28. Promar
14. Phostoxin	29. Avitrol
15. Aldrin	

TABLE D.2
LIST OF MAJOR PETROLEUM PRODUCT
STORAGE TANKS AT SHEPPARD AFB

Location	Number of Tanks	Volume per Tank (gallons)
JP-4 Storage Tanks		
Bulk Storage Area	1	1,100,000
Bulk Storage Area	2	825,000
Building 2520	8	65,450
Building 2540	8	65,450
Facility 30291	1	2,640
Diesel		
Building 2017	1	15,070
Building 2000	1	32,725
Facility 927	1	13,090
MOGAS		
Building 2017	1	15,070
Facility 921	2	2,640
Building 2015	1	32,725
Building 2015	1	(unleaded) 32,725

Source: Sheppard AFB Documents

TABLE D.3
LIST OF GREASE TRAPS, OIL SEPARATORS
(SAND TRAPS) AND POL DUMP TANKS

Building Number	[1]Type	Liquid Storage Capacity (gallons)
140	DT	150
55	OS	340
57	OS	340
988	OS	6000
1505	OS	500
2009	OS	3800
2023	OS	(2) 640
2120	OS	500
2119	OS	500
2122	OS	340
2320	OS	(3) 120
2325	OS	250
2325	OS	7480
2340	OS	500
2406	OS	1200
2408	OS	1200
2410	OS	1200
2552	OS	6750
340	GT	808
516	GT	750
526	GT	750
551	GT	(2) 1270
596	GT	700
643	GT	165
649	GT	1200
716	GT	750
726	GT	750
776	GT	750
811	GT	220
1108	GT	2500
1200	GT	750
2320	GT	(2) 15
991	OS	(3) 27
992	OS	750
4497	OS	4000
1929	OS	300
1960	OS	300
120	GT	440
61	GT	380
120	OS	340
2320	GT	15

Notes: [1] DT = Dump Tank
GT = Grease Trap
OS = Oil Separator (Sand Trap)

Source: Sheppard AFB Documents

TABLE D.4
ADDITIONAL SURFACE-WATER QUALITY DATA
FOR SHEPPARD AFB
(Parameter analyses are presented in milligrams per liter)

Parameter	Water Quality Standard: AFR 161-44 (Drinking Water)	Water Quality Standard: TDWR (Inland Waters)	Station Identification (Date Sampled; Month-Day-Year) Plum Creek: 3-81	6-81	9-81	12-81	6-15-82	9-7-82	12-15-82	3-25-83	6-17-83
Chemical Oxygen Demand	NS	NS	63	25	36	65	35	18	52	15	NA
Total Organic Carbon	NS	NS	18	8	26	19	20	12	14	11	NA
Oil and Greases	NS	NS	1	0.3	2	NA	1.4	0.6	48	144	NA
Cyanide	NS	NS	0.01	0.02	0.01	0.03	0.07	0.01	<0.1	<0.01	<0.01
Phenols	NS	NS	<0.010	NA	<0.010	0.038	<0.010	<0.010	0.010	<0.010	NA
Cadmium	0.01	0.05	<0.010	NA	NA	<0.010	NA	NA	NA	NA	<0.010
Chromium	0.05	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chromium, Hexavalent	NS	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Copper	NS	0.5	<0.080	<0.020	0.088	0.047	<0.020	0.020	<0.020	<0.020	<0.020
Iron	NS	NS	0.206	0.480	0.185	0.329	0.152	0.243	0.218	0.197	0.421
Lead	0.05	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.020
Manganese	NS	1.0	0.092	0.090	0.064	0.058	0.065	<0.050	<0.050	<0.050	0.057
Mercury	0.002	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002	<0.001
Nickel	NS	1.0	<0.050	<0.050	NA	<0.050	<0.050	0.097	<0.050	<0.050	NA
Silver	0.05	0.05	0.075	NA	NA	<0.010	NA	NA	NA	NA	<0.010
Zinc	NS	1.0	0.222	0.135	<0.050	0.121	<0.050	<0.050	0.063	<0.050	<0.050
Gold	NS	NS	NA	<0.010	<0.010	NA	NA	NA	NA	NA	<0.010
Chloride	NS	1,800	NA	NA	NA	148	220	NA	NA	NA	220
Fluoride	1.6	1.4-2.4	NA	NA	NA	0.8	NA	NA	NA	NA	1.3
Surfactants	NS	NS	0.3	0.3	0.6	0.6	0.4	0.3	0.5	0.2	NA
Aldrin	0.001	NS	ND	ND	0.00007	ND					
Chlordane	0.003	NS	ND	ND	0.0007	ND		(NOT ANALYZED)			
DDT Isomers	0.05	NS	ND	ND	ND	NA					
Dieldrin	0.001	NS	0.00004	ND	ND	ND					
Endrin	0.0002	0.0002	NA	NA	NA	ND					
Heptachlor	0.0001	NS	0.00004	ND	T	ND					
Heptachlor Epoxide	0.0001	NS	ND	ND	0.00006	ND					
Lindane	0.004	0.004	0.00001	ND	0.00003	0.00054					
Methoxychlor	0.1	0.1	ND	ND	ND	ND					
Toxaphene	0.005	0.005	ND	ND	0.0012	ND					
2,4-D	0.1	0.1	ND	ND	0.00014	ND					
2,4-5 TP Silvex	0.01	0.01	ND	ND	0.0002	0.000674					

Notes: T = Trace
ND = Not Detected
NA = Not Analyzed
TDWR = Texas Department of Water Resources

Source: Sheppard AFB Documents and Texas Surface Water Quality Standards, 1981 and 1982.

TABLE D.4
ADDITIONAL SURFACE-WATER QUALITY DATA
FOR SHEPPARD AFB
(Parameter analyses are presented in milligrams per liter)

Parameter	Water Quality Standard: AFR 161-44 (Drinking Water)	Water Quality Standard: TDWR (Inland Waters)	Station Identification (Date Sampled; Month-Day-Year) Clark's Pond: 3-81	6-81	9-81	12-81	6-15-82	9-10-82	12-17-82	3-24-83
Chemical Oxygen Demand	NS	NS	25	15	100	15	35	24	24	35
Total Organic Carbon	NS	NS	10	6	13	5	9	31	8	8
Oil and Greases	NS	NS	<0.3	<0.3	0.4	NA	<0.3	<0.3	37	0.5
Cyanide	NS	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenols	NS	NS	<0.010	NA	<0.010	<0.010	<0.010	0.046	0.015	0.012
Cadmium	0.01	0.05	<0.010	NA	NA	<0.010	NA	NA	NA	NA
Chromium	0.05	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chromium, Hexavalent	NS	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Copper	NS	0.5	<0.020	0.026	0.037	0.078	<0.020	<0.020	<0.020	<0.020
Iron	NS	NS	0.481	0.202	1.564	1.751	0.367	0.629	0.228	0.237
Lead	0.05	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese	NS	1.0	0.160	0.096	0.234	0.403	0.172	0.120	0.068	0.197
Mercury	0.002	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002
Nickel	NS	1.0	<0.050	<0.050	<0.050	<0.050	<0.050	0.156	<0.050	<0.050
Silver	0.05	0.05	0.030	NA	NA	<0.010	NA	NA	NA	NA
Zinc	NS	1.0	<0.050	0.051	<0.050	0.088	<0.050	<0.050	<0.050	<0.050
Gold	NS	NS	NA	<0.010	<0.020	NA	NA	NA	<0.010	<0.010
Chloride	NS	1,800	NA	NA	NA	144	272	NA	NA	NA
Fluoride	1.6	1.4-2.4	NA	NA	NA	0.8	NA	NA	NA	NA
Surfactants	NS	NS	0.2	0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.1
Aldrin	0.001	NS	ND	ND	ND	ND				
Chlordane	0.003	NS	ND	ND	ND	ND		(NOT ANALYZED)		
DDT Isomers	0.05	NS	ND	ND	NA	NA				
Dieldrin	0.001	NS	ND	ND	ND	ND				
Endrin	0.0002	0.0002	NA	NA	NA	ND				
Heptachlor	0.0001	NS	T	ND	ND	ND				
Heptachlor Epoxide	0.0001	NS								
Lindane	0.004	0.004		(NOT DETECTED)						
Methoxychlor	0.1	0.1								
Toxaphene	0.005	0.005								
2,4-D	0.1	0.1		(NOT DETECTED)						
2,4-5 TP Silvex	0.01	0.01								

Notes: T = Trace
ND = Not Detected
NA = Not Analyzed
TDWR = Texas Department of Water Resources

Source: Sheppard AFB Documents and Texas Surface Water Quality Standards, 1981 and 1982.

TABLE D.4
ADDITIONAL SURFACE-WATER QUALITY DATA
FOR SHEPPARD AFB
(Parameter analyses are presented in milligrams per liter)

Parameter	Water Quality Standard: AFR 161-44 (Drinking Water)	Water Quality Standard: TDWR (Inland Waters)	Station Identification (Date Sampled; Month-Day-Year), Bear Creek (Entrance): 3-81	6-81	9-81	12-81	6-14-82	9-10-82	12-17-82	3-24-83
Chemical Oxygen Demand	NS	NS	NA	24	NA	46	25	NA	69	35
Total Organic Carbon	NS	NS	NA	8	NA	16	20	NA	13	11
Oil and Greases	NS	NS	NA	0.3	NA	NA	3.5	NA	<0.3	0.8
Cyanide	NS	NS	NA	<0.01	NA	<0.01	<0.01	NA	<0.01	0.02
Phenols	NS	NS	NA	NA	NA	<0.010	22	NA	<0.010	<0.01
Cadmium	0.01	0.05	NA	NA	NA	<0.010	NA	NA	NA	NA
Chromium	0.05	0.5	NA	<0.050	NA	<0.050	<0.050	NA	<0.050	<0.050
Chromium, Hexavalent	NS	NS	NA	<0.050	NA	<0.050	<0.050	NA	<0.050	<0.050
Copper	NS	0.5	NA	<0.020	NA	0.056	<0.020	NA	<0.020	<0.020
Iron	NS	NS	NA	0.400	NA	0.399	1.349	NA	0.738	0.212
Lead	0.05	0.5	NA	<0.050	NA	<0.050	<0.050	NA	<0.050	<0.050
Manganese	NS	1.0	NA	0.090	NA	0.126	0.594	NA	0.248	0.057
Mercury	0.002	0.005	NA	<0.005	NA	<0.005	<0.005	NA	<0.002	<0.002
Nickel	NS	1.0	NA	<0.050	NA	<0.050	<0.050	NA	<0.050	<0.050
Silver	0.05	0.05	NA	NA	NA	<0.010	NA	NA	NA	NA
Zinc	NS	1.0	NA	<0.050	NA	0.062	<0.050	NA	0.664	0.097
Gold	NS	NS	NA	<0.010	NA	NA	NA	NA	<0.010	<0.010
Chloride	NS	1,800	NA	NA	NA	84	56	NA	NA	NA
Fluoride	1.6	1.4-2.4	NA	NA	NA	0.4	NA	NA	1.0	NA
Surfactants	NS	NS	NA	<0.1	NA	<0.1	<0.1	NA	12	0.2
Aldrin	0.001	NS	NA	ND	NA	ND				
Chlordane	0.003	NS	NA	ND	NA	ND		(NOT ANALYZED)		
DDT Isomers	0.05	NS	NA	ND	NA	ND				
Dieldrin	0.001	NS	NA	ND	NA	ND				
Endrin	0.0002	0.0002	NA	NA	NA	ND				
Heptachlor	0.0001	NS	NA	ND	NA	ND				
Heptachlor Epoxide	0.0001	NS	NA	ND	NA	ND				
Lindane	0.004	0.004	NA	ND	NA	ND				
Methoxychlor	0.1	0.1	NA	ND	NA	ND				
Toxaphene	0.005	0.005	NA	ND	NA	ND				
2,4-D	0.1	0.1	NA	ND	NA	ND				
2,4-5 TP Silvex	0.01	0.01	NA	ND	NA	ND				

Notes: T = Trace
ND = Not Detected
NA = Not Analyzed
TDWR = Texas Department of Water Resources

Source: Sheppard AFB Documents and Texas Surface Water Quality Standards, 1981 and 1982.

TABLE D.4
ADDITIONAL SURFACE-WATER QUALITY DATA
FOR SHEPPARD AFB
(Parameter analyses are presented in milligrams per liter)

Parameter	Water Quality Standard: AFR 161-44 (Drinking Water)	Water Quality Standard: TDWR (Inland Waters)	Station Identification (Date Sampled; Month-Day-Year) Bear Creek (Exit): 3-81	6-81	9-81	12-81	6-14-82	9-10-82	12-17-82	3-24-83
Chemical Oxygen Demand	NS	NS	30	32	35	28	25	36	58	40
Total Organic Carbon	NS	NS	11	9	18	10	25	12	17	9
Oil and Greases	NS	NS	<0.3	0.3	0.3	NA	<0.3	0.5	<0.3	30
Cyanide	NS	NS	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Phenols	NS	NS	<0.010	NA	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Cadmium	0.01	0.05	<0.010	NA	NA	<0.010	NA	NA	NA	NA
Chromium	0.05	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Chromium, Hexavalent	NS	NS	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Copper	NS	0.5	0.122	0.027	0.057	0.076	<0.020	<0.020	<0.020	<0.020
Iron	NS	NS	1.831	1.231	0.719	0.728	2.348	1.572	0.387	0.436
Lead	0.05	0.5	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050
Manganese	NS	1.0	0.541	0.946	0.169	0.184	0.697	0.334	0.248	1.040
Mercury	0.002	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.002	<0.002
Nickel	NS	1.0	<0.050	<0.050	<0.050	<0.050	0.150	0.136	<0.050	<0.050
Silver	0.05	0.05	0.038	NA	NA	<0.010	NA	NA	NA	NA
Zinc	NS	1.0	<0.050	0.053	<0.050	0.158	<0.050	<0.050	<0.050	0.062
Gold	NS	NS	NA	<0.010	<0.010	NA	NA	NA	<0.010	<0.010
Chloride	NS	1,800	NA	NA	NA	136	172	NA	NA	NA
Fluoride	1.6	1.4-2.4	NA	NA	NA	0.7	NA	NA	NA	NA
Surfactants	NS	NS	<0.1	0.2	0.1	<0.1	<0.1	0.2	0.1	0.2
Aldrin	0.001	NS	ND	ND	0.00014	ND				
Chlordane	0.003	NS	ND	ND	ND	ND		(NOT ANALYZED)		
DDT Isomers	0.05	NS	NA	ND	ND	NA				
Dieldrin	0.001	NS	0.00003	ND	ND	ND				
Endrin	0.0002	0.0002	NA	NA	NA	ND				
Heptachlor	0.0001	NS	T	ND	ND	ND				
Heptachlor Epoxide	0.0001	NS	ND	ND	ND	ND				
Lindane	0.004	0.004	T	ND	T	ND				
Methoxychlor	0.1	0.1	ND	ND	ND	ND				
Toxaphene	0.005	0.005	ND	ND	ND	ND				
2,4-D	0.1	0.1	ND	ND	0.0036	ND				
2,4-5 TP Silvex	0.01	0.01	ND	ND	ND	0.00018				

Notes: T = Trace
ND = Not Detected
NA = Not Analyzed
TDWR = Texas Department of Water Resources

Source: Sheppard AFB Documents and Texas Surface Water Quality Standards, 1981 and 1982.

APPENDIX E

MASTER LIST OF SHOPS

APPENDIX E
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
School of Health Care Sciences (SHCS)				
Department of Dentistry	1919	Yes	Yes	Silver Recovery
Department of Radiology	1900	Yes	Yes	Silver Recovery
USAF Regional Hospital Sheppard				
Dental Clinic	1200	Yes	Yes	Silver Recovery to Hospital Radiology Dept.
Radiology Services	1200	Yes	Yes	Silver Recovery
Radioisotope Laboratory	1200	No	No	--
Clinical Lab	1200	No	No	--
Operating Room	1200	Yes	Yes	Incinerated
Veterinary Clinic	61	Yes	Yes	Hospital Incinerator
3700 Technical Training Wing (TCHTW)				
Training Services/Audio-visual Division	844	Yes	Yes	Silver Recovery
Photo Lab	1020	Yes	Yes	Silver Recovery
3750 Technical Training Group (TCHTG)				
Missile Branch	1900	Yes	Yes	Contract Disposal

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
3750 Technical Training Group (TCHTG) (Continued)				
Electronic Principles	1020	No	No	--
Telephone Inside Branch	1950	No	No	--
Housing Course	1927	No	No	--
Teletype Branch	920	No	No	--
Environmental Support Course	1921	No	No	--
3760 Technical Training Group (TCHTG)				
Aircraft Maintenance Branch	1040	No	No	--
Aircraft Principles Branch	1010	No	No	--
Helecopter Course	1040	Yes	Yes	In Storage for Contracted Disposal
3770 Technical Training Group (TCHTG)				
Corrosion Control Course	1927/1928	Yes	Yes	Contract Disposal
Plumbing Course	1921	No	No	--
Entomology Course	1927/1929	Yes	Yes	Storm Sewer, Wash Rack
Pavement Maintenance Course	1927/1929	No	No	--

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
3770 Technical Training Group (TCHTG) (Continued)				
Metal Fabrication Course	1928	No	No	--
Carpentry Course	2001	No	No	--
Electric Power Production Course	2001	Yes	Yes	Contract Disposal
Masonry Course	2013	No	No	--
Site Development Course	1927	Yes	Yes	Disposed with Corrosion Control Course Work
3750th Consolidated Maintenance Squadron				
Carpenter Shop	1360	No	No	--
Corrosion Control/Work Rack	1360	Yes	Yes	On-site Storage and Contract Disposal
Metals Processing Shop	1360	No	No	--
Structral Repair Shop	1360	No	No	--
PMEL	1364	Yes	Yes	Recycled
Battery and Electrical Environmental Systems	1360	Yes	Yes	Neutralized to Sanitary Sewer
AGE Shop	1360	Yes	Yes	Contract Disposal
Pneudraulics and Propulsion	1360	Yes	Yes	Contract Disposal

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
3750th Consolidated Maintenance Squadron (Continued)				
Fabric and Parachute	1360	No	No	--
Avionics	1360	No	No	--
Machine Shop	1360	No	No	--
Aircraft Trainer Maintenance	1060	Yes	Yes	AGE Yard Accumulation Point
3750 Supply Squadron				
Fuels Management Laboratory	2017	Yes	Yes	Contract Disposal
3750 Transportation Division				
Packing and Crating	WHSE 1	No	No	--
Body Shop	2130	Yes	No	--
Tire Shop	2130	No	No	--
Tire Truck Shop	2130	Yes	Yes	Contract Disposal
Heavy Equipment Repair	2130	Yes	Yes	Contract Disposal
General Purpose Vehicle Repair	2130	Yes	Yes	Contract Disposal

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
3750 Air Base Group				
Small Arms Range	2125	No	No	--
Printing Plant	T-60	Yes	Yes	Silver Recovery
Arts and Crafts	832	No	No	--
Auto Hobby Shop	55	Yes	Yes	Contract Disposal
BX Complex	1126/1400	Yes	Yes	Contract Disposal
3750 Civil Engineering Squadron				
Boiler Repair	1502	No	No	--
Pavements	2141	No	No	--
Golf Course Maintenance	4493	Yes	Yes	Rinsate on Application Areas
Entomology	1391	Yes	Yes	Rinsate on Ground Adjacent to Building
Water Plant	140	Yes	No	--
Water and Waste	1380	Yes	No	--
Heating Shop	1501	No	No	--
Plumbing Shop	1501	No	No	--
Welding and Sheet Metal Shop	1501	No	No	--
Paint Shop	1502	Yes	No	--

APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
3750 Civil Engineering Squadron (Continued)				
Carpenter Shop	1502	No	No	--
Air Conditioning and Refridgeration Shop	1501	Yes	No	--
Equipment Shop	2141	No	No	--
Power Production	1506	Yes	Yes	To Storm Drainage
Grounds	2141	No	No	--
Interior/Exterior Electrics	1501	Yes	Yes	Contract Disposal
2054 Communications Squadron				
Main Control	2560	No	No	--
Radar Maintenance	2560	No	No	--
Radio Maintenance	2560	No	No	--
Telephone Missile Maintenance	1450	No	No	--
Teletype Maintenance	920	No	No	--
Northrop Contractor				
NDI Lab	2412	Yes	Yes	Contract Disposal
T-38 Unscheduled Shop	2404	Yes	Yes	Contract Disposal

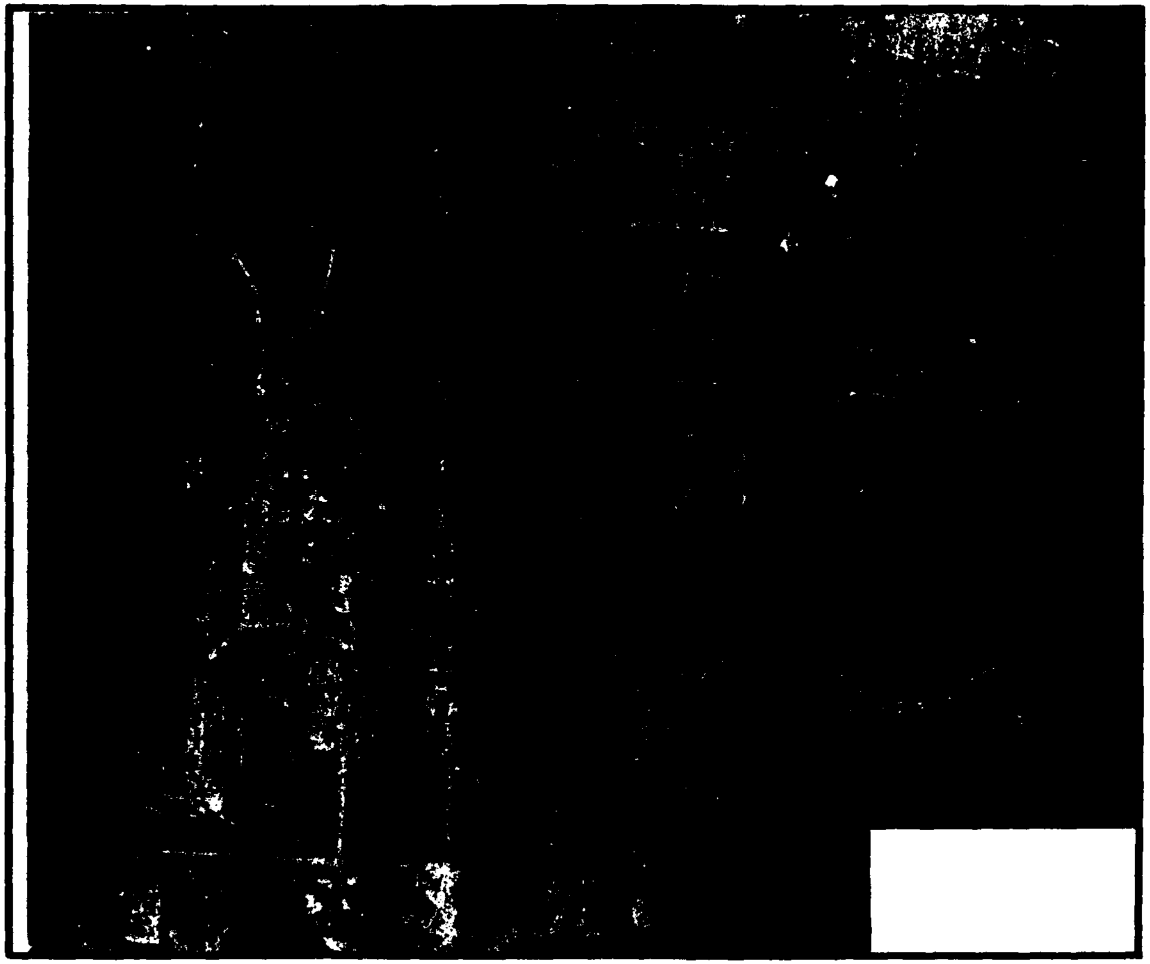
APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
Northrop Contractor (Continued)				
Radio Shop	2320	Yes	Yes	Contract Disposal
Electric P-1 Shop	2320	No	No	--
Instrument Shop	2320	No	No	--
Engine Shop	2325	Yes	Yes	Contract Disposal
Sheet Metal Shop	2320	No	No	--
Welding Shop	2320	No	No	--
MARS 11-11 Shop	2320	No	No	--
Machine Shop	2320	No	No	--
Hydraulic P-2 Shop	2320	Yes	Yes	Contract Disposal
Tire Shop	2320	Yes	Yes	Contract Disposal
Scheduled Dock Shop	2406	Yes	Yes	Contract Disposal
Test Cell Shop	2510	Yes	Yes	Contract Disposal
T-37 Unscheduled Shop	2140	Yes	Yes	Contract Disposal
AGE Shop	2410	Yes	Yes	Contract Disposal
Express Shop	2406	No	No	--
Corrosion Control Shop	2408	Yes	Yes	Contract Disposal

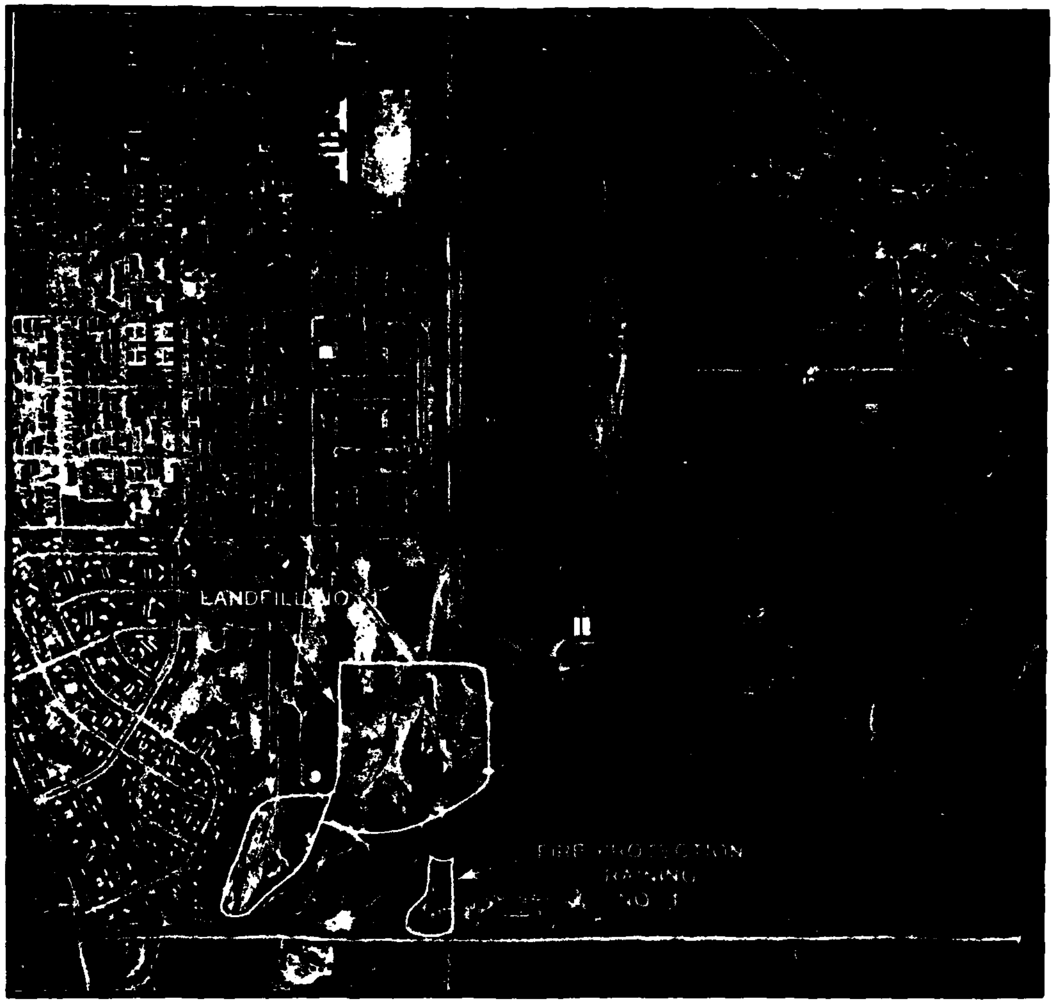
APPENDIX E
(Continued)
MASTER LIST OF SHOPS

Name	Present Location (Bldg. No.)	Handles Hazardous (CERCLA) Materials	Generates Hazardous (CERCLA) Wastes	Typical TSD Methods
Northrop Contractor (Continued)				
Vehicle Maintenance Shop	2340	Yes	Yes	Contract Disposal
Paint Shop	2404	Yes	Yes	Contract Disposal
Battery Shop	2404	Yes	Yes	Contract Disposal
Instrument Flight	2320	Yes	No	--

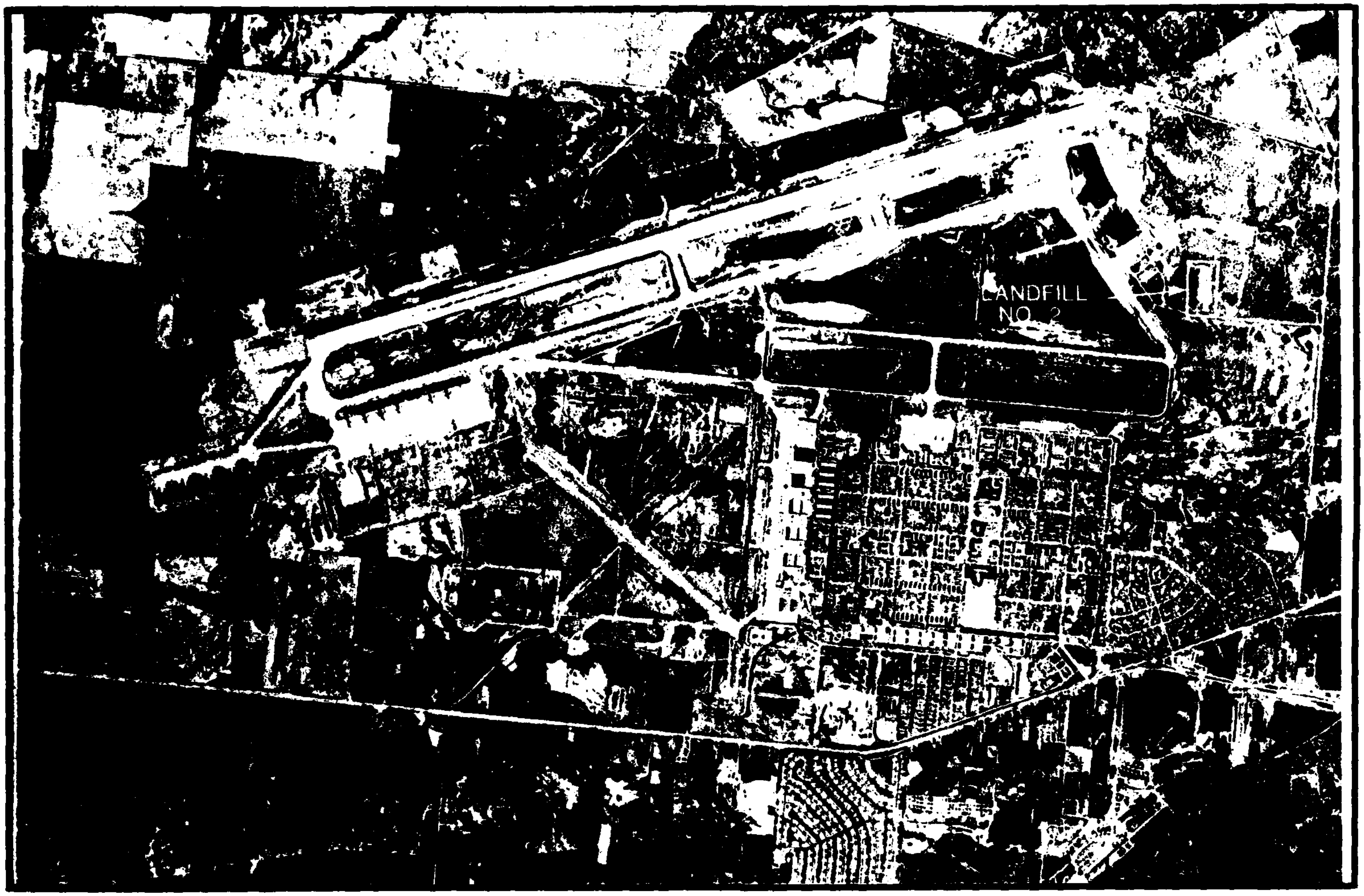
APPENDIX F
SITE PHOTOGRAPHS



SHEPPARD AFB
1943



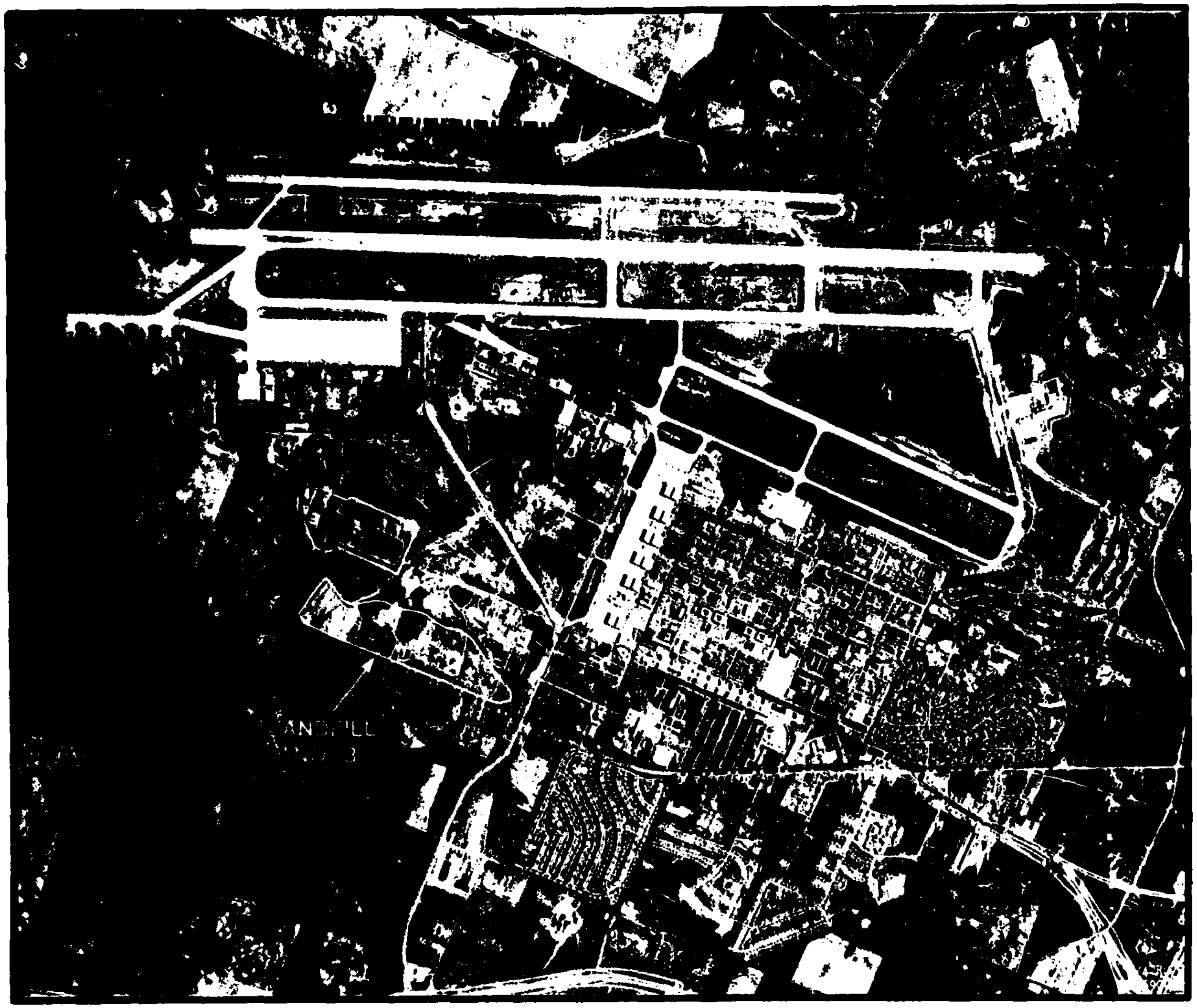
SHEPPARD AFB
SOUTH END OF BASE
MAY 7, 1955



SHEPPARD AFB

OCTOBER 4, 1961

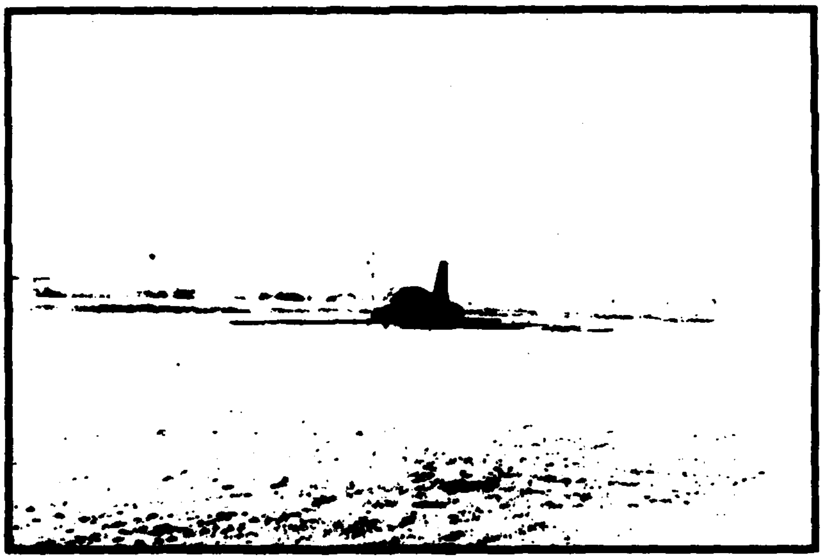
SHEPPARD AFB
1963



SHEPPARD AFB
NOVEMBER 2, 1970

SHEPPARD AFB

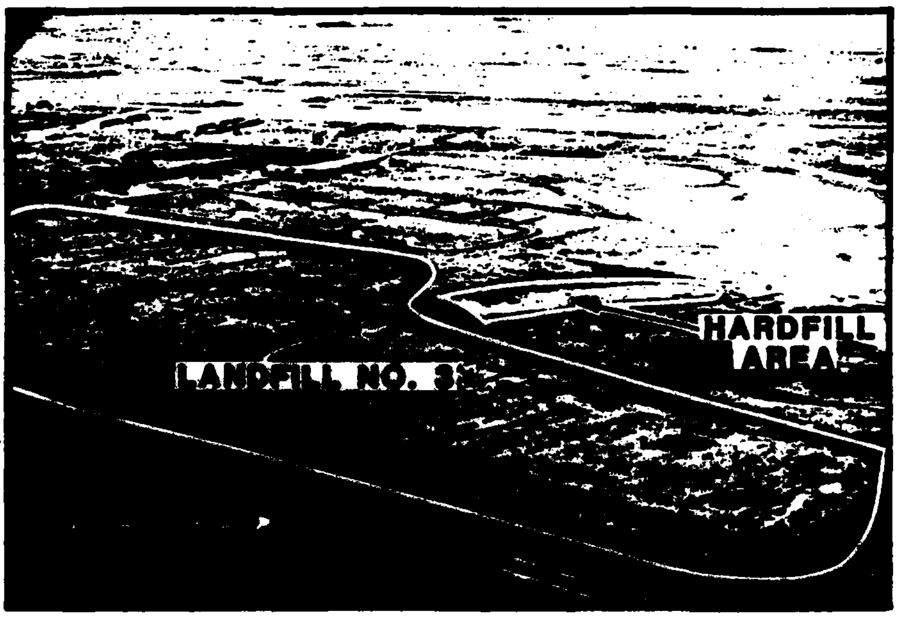
October 26, 1983



FPTA No. 3, T-38 Mockup
(Facing Northeast)

SHEPPARD AFB
October 26, 1983

Landfill No. 3, North End
(Facing Northeast)



Landfill No. 3 and Hardfill Area
(Facing Northeast)

SHEPPARD AFB
October 26, 1983

Hardfill Area
(Facing Northwest)

Waste Pit Area
(Looking Southwest From Avenue H)

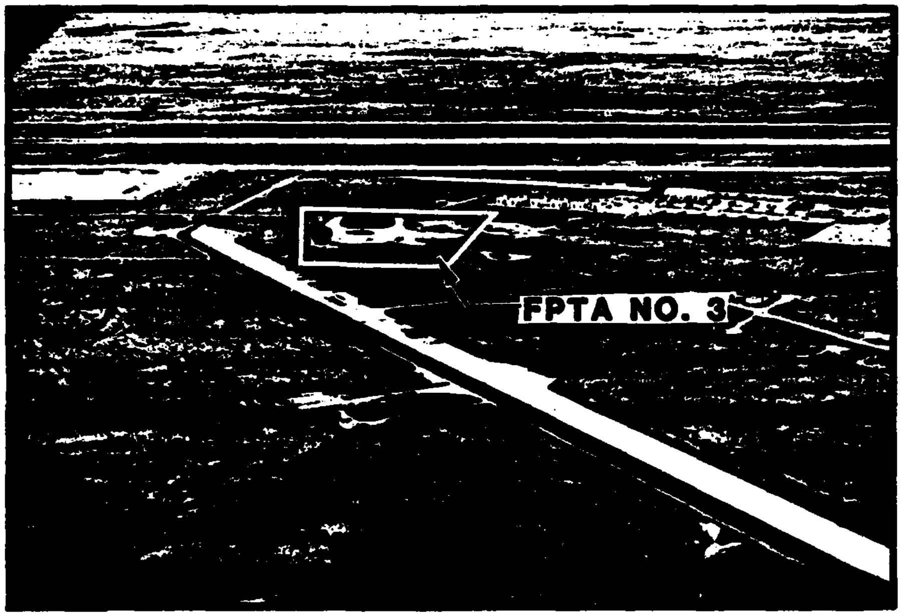
SHEPPARD AFB

October 26, 1983

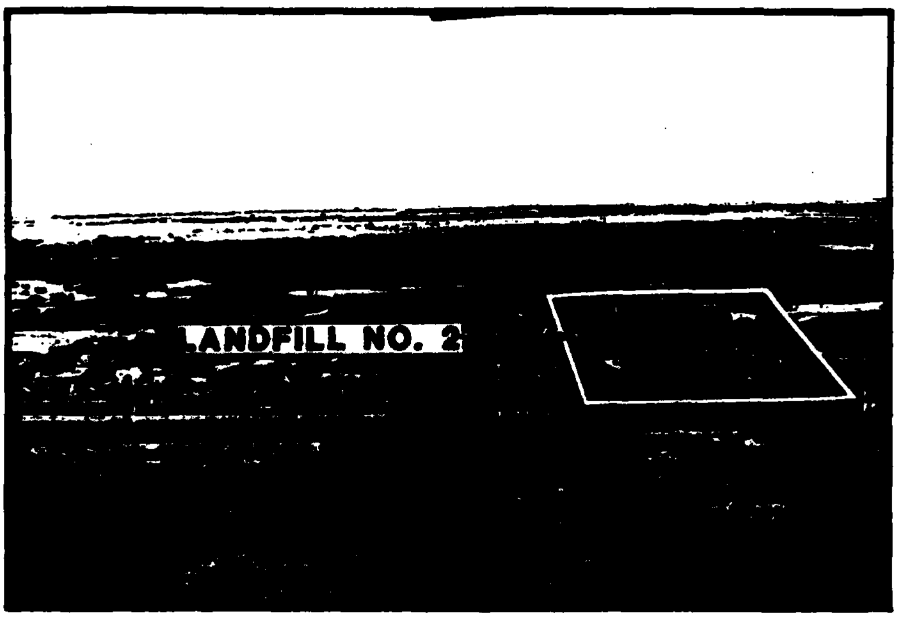
Radioactive Waste Disposal Well Near WPT

Radioactive Waste Disposal Site In Landfill No. 3

SHEPPARD AFB
October 26, 1983



FPTA No. 3
(Facing East)



Landfill No. 2
(Facing East)

APPENDIX G

HAZARD ASSESSMENT RATING METHODOLOGY

APPENDIX G

USAF INSTALLATION RESTORATION PROGRAM

HAZARD ASSESSMENT RATING METHODOLOGY

BACKGROUND

The Department of Defense (DOD) has established a comprehensive program to identify, evaluate, and control problems associated with past disposal practices at DOD facilities. One of the actions required under this program is to:

> "develop and maintain a priority listing of contaminated installations and facilities for remedial action based on potential hazard to public health, welfare, and environmental impacts." (Reference: DEQPPM 81-5, aa December 1981).

Accordingly, the United States Air Force (USAF) has sought to establish a system to set priorities for taking further actions at sites based upon information gathered during the Secords Search phase of its Installation Restoration Program (IRP).

The first site rating model was developed in June 1981 at a meeting with represenatives from USAF Occupational and Environmental Health Laboratory (OEHL), Air Force Engineering and Services Center (AFESC), Engineering-Science (ES) and CH2M Hill. The basis for this model was a system developed for EPA by JRB Associates of McLean, Virginia. The JRB model was modified to meet Air Force needs.

After using this model for 6 months at over 20 Air Force installations, certain inadequacies became apparent. Therefore, on January 26 and 27, 1982, representatives of USAF OEHL, AFESC, various major commands, Engineering-Science, and CH2M Hill met to address the inadequacies. The result of the meeting was a new site rating model designed to present a better picture of the hazards posed by sites at Air Force installations. The new rating model described in this presentation is referred to as the Hazard Assessment Rating Methodology.

PURPOSE

The purpose of the site rating model is to provide a relative ranking of sites of suspected contamination from hazardous substances. This model will assist the Air Force in setting priorities for follow-on site investigations and confirmation work under Phase II of the IRP.

This rating system is used only after it has been determined that (1) potential for contamination exists (hazardous wastes present in sufficient quantity), and (2) potential for migration exists. A site can be deleted from consideration for rating on either basis.

DESCRIPTION OF MODEL

Like the other hazardous waste site ranking models, the U.S. Air Force's site rating model uses a scoring system to rank sites for priority attention. However, in developing this model, the designers incorporated some special features to meet specific DOD program needs.

The model uses data readily obtained during the Records Search portion (Phase I) of the IRP. Scoring judgments and computations are easily made. In assessing the hazards at a given site, the model develops a score based on the most likely routes of contamination and the worst hazards at the site. Sites are given low scores only if there are clearly no hazards at the site. This approach meshes well with the policy for evaluating and setting restrictions on excess DOD properties.

As with the previous model, this model considers four aspects of the hazard posed by a specific site: the possible receptors of the contamination, the waste and its characteristics, potential pathways for waste contaminant migration, and any efforts to contain the contaminants. Each of these categories contains a number of rating factors that are used in the overall hazard rating.

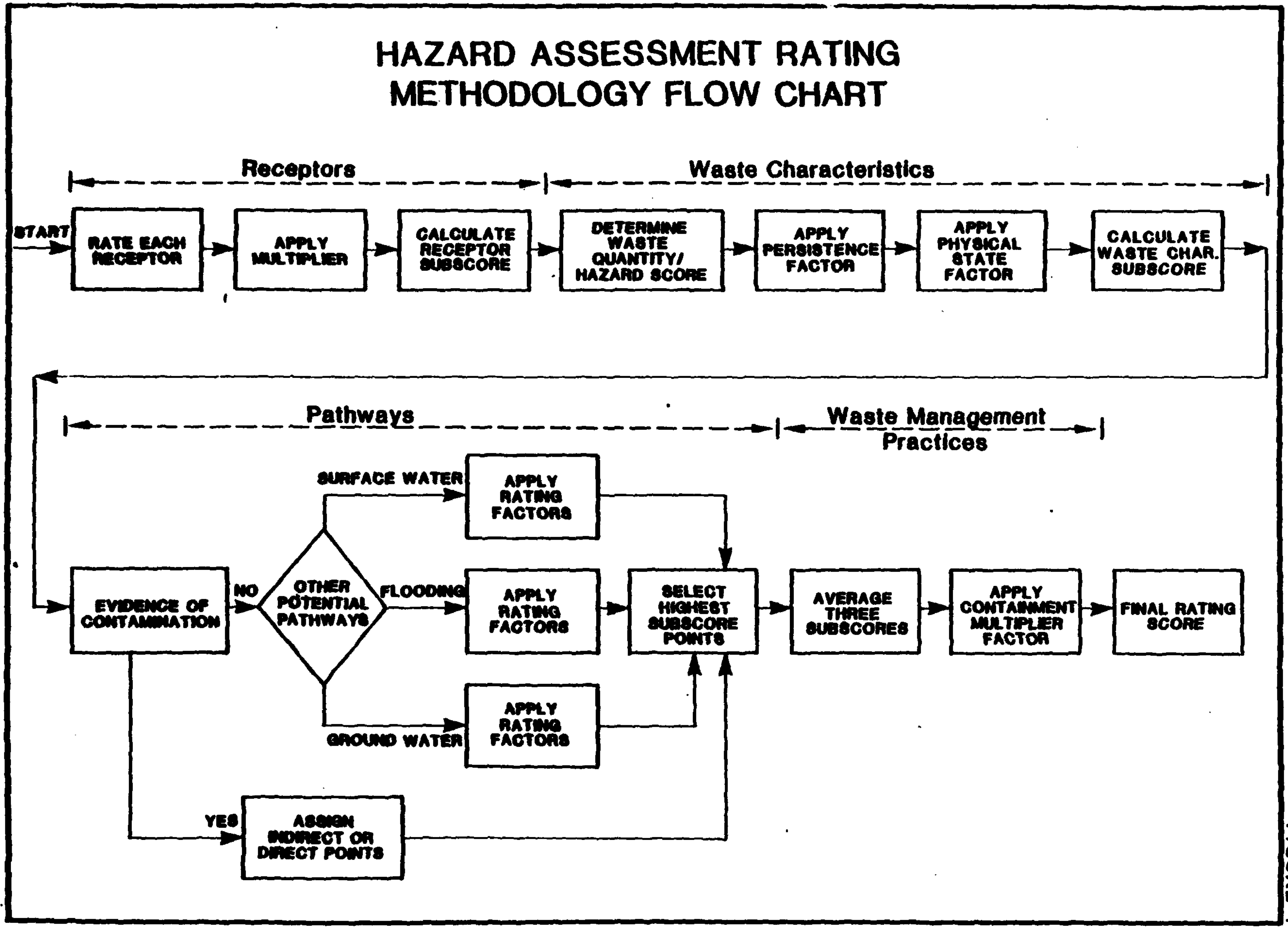
The receptors category rating is calculated by scoring each factor, multiplying by a factor weighting constant and adding the weighted scores to obtain a total category score.

The pathways category rating is based on evidence of contaminant migration or an evaluation of the highest potential (worst case) for contaminant migration along one of three pathways. If evidence of contaminant migration exists, the category is given a subscore of 80 to 100 points. For indirect evidence, 80 points are assigned and for direct evidence, 100 points are assigned. If no evidence is found, the highest score among three possible routes is used. These routes are surface water migration, flooding, and ground-water migration. Evaluation of each route involves factors associated with the particular migration route. The three pathways are evaluated and the highest score among all four of the potential scores is used.

The waste characteristics category is scored in three steps. First, a point rating is assigned based on an assessment of the waste quantity and the hazard (worst case) associated with the site. The level of confidence in the information is also factored into the assessment. Next, the score is multiplied by a waste persistence factor, which acts to reduce the score if the waste is not very persistent. Finally, the score is further modified by the physical state of the waste. Liquid wastes receive the maximum score, while scores for sludges and solids are reduced.

The scores for each of the three categories are then added together and normalized to a maximum possible score of 100. Then the waste management practice category is scored. Sites at which there is no containment are not reduced in score. Scores for sites with limited containment can be reduced by 5 percent. If a site is contained and well managed, its score can be reduced by 90 percent. The final site score is calculated by applying the waste management practices category factor to the sum of the scores for the other three categories.

FIGURE 1



HAZARD ASSESSMENT RATING
METHODOLOGY FLOW CHART
Receptors
Waste Characteristics
START
RATE EACH RECEPTOR
APPLY MULTIPLIER
CALCULATE RECEPTOR SUBSCORE
DETERMINE WASTE QUANTITY/ HAZARD SCORE
APPLY PERSISTENCE FACTOR
APPLY PHYSICAL STATE FACTOR
CALCULATE WASTE CHAR. SUBSCORE
Pathways
Waste Management Practices
EVIDENCE OF CONTAMINATION
NO
OTHER POTENTIAL PATHWAYS
SURFACE WATER
FLOODING
GROUND WATER
APPLY RATING FACTORS
APPLY RATING FACTORS
APPLY RATING FACTORS
SELECT HIGHEST SUBSCORE POINTS
AVERAGE THREE SUBSCORES
APPLY CONTAINMENT MULTIPLIER FACTOR
FINAL RATING SCORE
YES
ASSIGN INDIRECT OR DIRECT POINTS

FIGURE 2

HAZARD ASSESSMENT RATING METHODOLOGY FORM

NAME OF SITE ____________________

LOCATION ____________________

DATE OF OPERATION OR OCCURRENCE ____________________

OWNER/OPERATOR ____________________

COMMENTS/DESCRIPTION ____________________

SITE RATED BY ____________________

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site		4		
B. Distance to nearest well		10		
C. Land use/zoning within 1 mile radius		3		
D. Distance to reservation boundary		6		
E. Critical environments within 1 mile radius of site		10		
F. Water quality of nearest surface water body		6		
G. Ground water use of uppermost aquifer		9		
H. Population served by surface water supply within 3 miles downstream of site		6		
I. Population served by ground-water supply within 3 miles of site		6		

Subtotals ______ ______

Receptors subscore (100 X factor score subtotal/maximum score subtotal) ______

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (S = small, M = medium, L = large) ______
2. Confidence level (C = confirmed, S = suspected) ______
3. Hazard rating (H = high, M = medium, L = low) ______

Factor Subscore A (from 20 to 100 based on factor score matrix) ______

B. Apply persistence factor
Factor Subscore A X Persistence Factor = Subscore B

______ X ______ = ______

C. Apply physical state multiplier

Subscore B X Physical State Multiplier = Waste Characteristics Subscore

______ X ______ = ______

FIGURE 2 (Continued)

III. PATHWAYS

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore _______

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating, and proceed to C.

1. Surface water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Distance to nearest surface water		8		
Net precipitation		6		
Surface erosion		8		
Surface permeability		6		
Rainfall intensity		8		

Subtotals _______ _______

Subscore (100 X factor score subtotal/maximum score subtotal) _______

2. Flooding

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Flooding		1		

Subscore (100 x factor score/3) _______

3. Ground-water migration

Rating Factor	Factor Rating (0-3)	Multiplier	Factor Score	Maximum Possible Score
Depth to ground water		8		
Net precipitation		6		
Soil permeability		8		
Subsurface flows		8		
Direct access to ground water		8		

Subtotals _______ _______

Subscore (100 x factor score subtotal/maximum score subtotal) _______

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore _______

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors _______
Waste Characteristics _______
Pathways _______

Total _________ divided by 3 = _______
Gross Total Score

B. Apply factor for waste containment from waste management practices

Gross Total Score X Waste Management Practices Factor = Final Score

_____________ X _____________ = [ ]

TABLE 1

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

I. RECEPTORS CATEGORY

Rating Factors	Rating Scale Levels 0	1	2	3	Multiplier
A. Population within 1,000 feet (includes on-base facilities)	0	1 - 25	26 - 100	Greater than 100	4
B. Distance to nearest water well	Greater than 3 miles	1 to 3 miles	3,001 feet to 1 mile	0 to 3,000 feet	10
C. Land Use/Zoning (within 1 mile radius)	Completely remote (zoning not applicable)	Agricultural	Commercial or industrial	Residential	3
D. Distance to installation boundary	Greater than 2 miles	1 to 2 miles	1,001 feet to 1 mile	0 to 1,000 feet	6
E. Critical environments (within 1 mile radius)	Not a critical environment	Natural areas	Pristine natural areas; minor wetlands; preserved areas; presence of economically important natural resources susceptible to contamination.	Major habitat of an endangered or threatened species; presence of recharge area; major wetlands.	10
F. Water quality/use designation of nearest surface water body	Agricultural or industrial use.	Recreation, propagation and management of fish and wildlife.	Shellfish propagation and harvesting.	Potable water supplies	6
G. Ground-Water use of uppermost aquifer	Not used, other sources readily available.	Commercial, industrial, or irrigation, very limited other water sources.	Drinking water, municipal water available.	Drinking water, no municipal water available; commercial, industrial, or irrigation, no other water source available.	9
H. Population served by surface water supplies within 3 miles downstream of site	0	1 - 50	51 - 1,000	Greater than 1,000	6
I. Population served by aquifer supplies within 3 miles of site	0	1 - 50	51 - 1,000	Greater than 1, 000	6

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS

A-1 Hazardous Waste Quantity

S = Small quantity (<5 tons or 20 drums of liquid)
M = Moderate quantity (5 to 20 tons or 21 to 85 drums of liquid)
L = Large quantity (>20 tons or 85 drums of liquid)

A-2 Confidence Level of Information

C = Confirmed confidence level (minimum criteria below)

- o Verbal reports from interviewer (at least 2) or written information from the records.
- o Knowledge of types and quantities of wastes generated by shops and other areas on base.
- o Based on the above, a determination of the types and quantities of waste disposed of at the site.

S = Suspected confidence level

- o No verbal reports or conflicting verbal reports and no written information from the records.
- o Logic based on a knowledge of the types and quantities of hazardous wastes generated at the base, and a history of past waste disposal practices indicate that these wastes were disposed of at a site.

A-3 Hazard Rating

Hazard Category	Rating Scale Levels 0	1	2	3
Toxicity	Sax's Level 0	Sax's Level 1	Sax's Level 2	Sax's Level 3
Ignitability	Flash point greater than 200°F	Flash point at 140°F to 200°F	Flash point at 80°F to 140°F	Flash point less than 80°F
Radioactivity	At or below background levels	1 to 3 times background levels	3 to 5 times background levels	Over 5 times background levels

Use the highest individual rating based on toxicity, ignitability and radioactivity and determine the hazard rating.

Hazard Rating	Points
High (H)	3
Medium (M)	2
Low (L)	1

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

II. WASTE CHARACTERISTICS (Continued)

Waste Characterization Matrix

Point Rating	Hazardous Waste Quantity	Confidence Level of Information	Hazard Rating
100	L	C	H
80	L	C	M
	M	C	H
70	L	S	H
60	S	C	H
	M	C	M
50	L	S	M
	L	C	L
	M	S	H
	S	C	M
40	S	S	H
	M	S	M
	M	C	L
	L	S	L
30	S	C	L
	M	S	L
	S	S	M
20	S	S	L

Notes:
For a site with more than one hazardous waste, the waste quantities may be added using the following rules:
Confidence Level
- o Confirmed confidence levels (C) can be added
- o Suspected confidence levels (S) can be added
- o Confirmed confidence levels cannot be added with suspected confidence levels

Waste Hazard Rating
- o Wastes with the same hazard rating can be added
- o Wastes with different hazard ratings can only be added in a downgrade mode, e.g., MCM + SCH = LCM if the total quantity is greater than 20 tons.

Example: Several wastes may be present at a site, each having an MCM designation (60 points). By adding the quantities of each waste, the designation may change to LCM (80 points). In this case, the correct point rating for the waste is 80.

B. Persistence Multiplier for Point Rating

Persistence Criteria	Multiply Point Rating From Part A by the Following
Metals, polycyclic compounds, and halogenated hydrocarbons	1.0
Substituted and other ring compounds	0.9
Straight chain hydrocarbons	0.8
Easily biodegradable compounds	0.4

C. Physical State Multiplier

Physical State	Multiply Point Total From Parts A and B by the Following
Liquid	1.0
Sludge	0.75
Solid	0.50

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

III. PATHWAYS CATEGORY

A. Evidence of Contamination

Direct evidence is obtained from laboratory analyses of hazardous contaminants present above natural background levels in surface water, ground water, or air. Evidence should confirm that the source of contamination is the site being evaluated.

Indirect evidence might be from visual observation (i.e., leachate), vegetation stress, sludge deposits, presence of taste and odors in drinking water, or reported discharges that cannot be directly confirmed as resulting from the site, but the site is greatly suspected of being a source of contamination.

Rating Factor	Rating Scale Levels 0	1	2	3	Multiplier
B-1 POTENTIAL FOR SURFACE WATER CONTAMINATION					
Distance to nearest surface water (includes drainage ditches and storm sewers)	Greater than 1 mile	2,001 feet to 1 mile	501 feet to 2,000 feet	0 to 500 feet	8
Net precipitation	Less than -10 in.	-10 to + 5 in.	+5 to +20 in.	Greater than +20 in.	6
Surface erosion	None	Slight	Moderate	Severe	8
Surface permeability	0% to 15% clay ($>10^{-2}$ cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	Greater than 50% clay ($<10^{-6}$ cm/sec)	6
Rainfall intensity based on 1 year 24-hr rainfall	<1.0 inch	1.0-2.0 inches	2.1-3.0 inches	>3.0 inches	8
B-2 POTENTIAL FOR FLOODING					
Floodplain	Beyond 100-year floodplain	In 25-year floodplain	In 10-year floodplain	Floods annually	1
B-3 POTENTIAL FOR GROUND-WATER CONTAMINATION					
Depth to ground water	Greater than 500 ft	50 to 500 feet	11 to 50 feet	0 to 10 feet	8
Net precipitation	Less than -10 in.	-10 to +5 in.	+5 to +20 in.	Greater than +20 in.	6
Soil permeability	Greater than 50% clay ($>10^{-6}$ cm/sec)	30% to 50% clay (10^{-4} to 10^{-6} cm/sec)	15% to 30% clay (10^{-2} to 10^{-4} cm/sec)	0% to 15% clay ($<10^{-2}$ cm/sec)	8
Subsurface flows	Bottom of site greater than 5 feet above high ground-water level	Bottom of site occasionally submerged	Bottom of site frequently submerged	Bottom of site located below mean ground-water level	8
Direct access to ground water (through faults, fractures, faulty well casings, subsidence fissures, etc.)	No evidence of risk	Low risk	Moderate risk	High risk	8

TABLE 1 (Continued)

HAZARD ASSESSMENT RATING METHODOLOGY GUIDELINES

IV. WASTE MANAGEMENT PRACTICES CATEGORY

A. This category adjusts the total risk as determined from the receptors, pathways, and waste characteristics categories for waste management practices and engineering controls designed to reduce this risk. The total risk is determined by first averaging the receptors, pathways, and waste characteristics subscores.

B. WASTE MANAGEMENT PRACTICES FACTOR

The following multipliers are then applied to the total risk points (from A):

Waste Management Practice	Multiplier
No containment	1.0
Limited containment	0.95
Fully contained and in full compliance	0.10

Guidelines for fully contained:

Landfills:

- o Clay cap or other impermeable cover
- o Leachate collection system
- o Liners in good condition
- o Adequate monitoring wells

Spills:

- o Quick spill cleanup action taken
- o Contaminated soil removed
- o Soil and/or water samples confirm total cleanup of the spill

Surface Impoundments:

- o Liners in good condition
- o Sound dikes and adequate freeboard
- o Adequate monitoring wells

Fire Proection Training Areas:

- o Concrete surface and berms
- o Oil/water separator for pretreatment of runoff
- o Effluent from oil/water separator to treatment plant

General Note: If data are not available or known to be complete the factor ratings under items I-A through I, III-B-1 or III-B-3, then leave blank for calculation of factor score and maximum possible score.

APPENDIX H

SITE ASSESSMENT RATING FORMS

HAZARD ASSESSMENT RATING METHODOLOGY FORMS

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HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Waste Pits
Location:Near Building 2320
Date of Operation or Occurrence: 1966 - mid 1970's
Owner/Operator: Sheppard AFB
Comments/Description: Used for storage of engine cleaners, and other organic liquids

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			55	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 0.80 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			62	108
Subscore (100 x factor score subtotal/maximum score subtotal)				57
2. Flooding	1	1	1	3
Subscore (100 x factor score/3)				33
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	2	8	16	24
Direct access to ground water	2	8	16	24
Subtotals			72	114
Subscore (100 x factor score subtotal/maximum score subtotal)				63

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 63

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors		31
Waste Characteristics		80
Pathways		63
Total	174 divided by 3 =	58 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

58 x 1.00 = 58

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No.3
Location: Northwest corner of base
Date of Operation or Occurrence: 1957 - 1972
Owner/Operator: Sheppard AFB
Comments/Description: Includes hardfill area. Oils buried in trench operation during the 1960's.
Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			58	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 32

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 0.80 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	1	1	1	3
Subscore (100 x factor score/3)				33
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	32
Waste Characteristics	80
Pathways	50
Total	162 divided by 3 = 54 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

54 x 1.00 = 54 FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area No. 3
Location: Bridwell Road
Date of Operation or Occurrence: 1957 - present
Owner/Operator: Sheppard AFB
Comments/Description: Oil-water separator system adjacent to this area

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			49	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 27

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 0.80 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	2	8	16	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			62	108
Subscore (100 x factor score subtotal/maximum score subtotal)				57
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 57

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	27	
Waste Characteristics	80	
Pathways	57	
Total	164 divided by 3 =	55 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

55 x 0.95 = 52

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area No. 1
Location: Presently golf course
Date of Operation or Occurrence: 1941 - 1957
Owner/Operator: Sheppard AFB
Comments/Description: Adjacent to Landfill No. 1

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			55	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 100

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

100 x 0.80 = 80

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

80 x 1.00 = 80

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	2	8	16	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 43

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	31	
Waste Characteristics	80	
Pathways	43	
Total	154 divided by 3 =	51 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

51 x 1.00 = 51

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Fire Protection Training Area No. 2
Location: Near main runway
Date of Operation or Occurrence: 1962 - 1970
Owner/Operator: Sheppard AFB
Comments/Description: Used for LBR unit practice

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	0	4	0	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			37	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 21

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 3

Factor Subscore A (from 20 to 100 based on factor score matrix) 80

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

80 x 0.80 = 64

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

64 x 1.00 = 64

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	0	8	0	24
Direct access to ground water	0	8	0	24
Subtotals			40	114
Subscore (100 x factor score subtotal/maximum score subtotal)				35

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	21
Waste Characteristics	64
Pathways	50
Total	135 divided by 3 = 45 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

45 x 1.00 = 45

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Industrial Waste Pit
Location:Waste Treatment Plant
Date of Operation or Occurrence: 1950's
Owner/Operator: Sheppard AFB
Comments/Description: Present use is as overflow basin from oil-water separator

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			52	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 29

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 3
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.80 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 1.00 = 40

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 49

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	29	
Waste Characteristics	40	
Pathways	49	
Total	118 divided by 3 =	39 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

39 x 1.00 = 39

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No.1
Location: Presently golf course
Date of Operation or Occurrence: 1940's - 1957
Owner/Operator: Sheppard AFB
Comments/Description: General refuse disposal

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			55	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 50

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

50 x 0.80 = 40

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

40 x 0.80 = 32

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	31
Waste Characteristics	32
Pathways	50
Total	113 divided by 3 = 38 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

38 x 1.00 = 38 FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Pesticide Spray Area
Location: Waste Treatment Plant
Date of Operation or Occurrence: 1940's - present
Owner/Operator: Sheppard AFB
Comments/Description: Sprayed onto gravel parking lot at WTP

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	2	6	12	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			52	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 29

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 2

Factor Subscore A (from 20 to 100 based on factor score matrix) 30

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

30 x 1.00 = 30

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

30 x 1.00 = 30

Name of Site: Pesticide Spray Area

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 49

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	29	
Waste Characteristics	30	
Pathways	49	
Total	108 divided by 3 =	36 Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

36 x 1.00 = 36

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site:Low-Level Radioactive Waste Disposal Site in Landfill No. 3
Location:Landfill No. 3
Date of Operation or Occurrence: 1960's - present
Owner/Operator: Sheppard AFB
Comments/Description: No records indicate use of this site

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	3	3	9	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			58	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 32

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 1.00 = 20

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

20 x 0.50 = 10

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	1	1	1	3
Subscore (100 x factor score/3)				33
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.
Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	32		
Waste Characteristics	10		
Pathways	50		
Total	92 divided by 3 =	31	Gross total score

B. Apply factor for waste containment from waste management practices.
Gross total score x waste management practices factor = final score

31 x 1.00 = 31

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Landfill No.2
Location:South of municipal plant
Date of Operation or Occurrence: Early 1960's
Owner/Operator: Sheppard AFB
Comments/Description: General refuse disposal

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			55	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 2
2. Confidence level (1=confirmed, 2=suspected) 1
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 40

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

40 x 0.40 = 16

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

16 x 0.50 = 8

Name of Site: Landfill No.2 Page 2 of 2

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	1	8	8	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			54	108
Subscore (100 x factor score subtotal/maximum score subtotal)				50
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 50

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	31	
Waste Characteristics	8	
Pathways	50	
Total	89 divided by 3 =	30 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

30 x 1.00 = 30

FINAL SCORE

HAZARD ASSESSMENT RATING METHODOLOGY FORM

Name of Site: Low-Level Radioactive Waste Disposal Site at Waste Treatment Plant
Location: Waste Treatment Plant
Date of Operation or Occurrence: 1960's - present
Owner/Operator: Sheppard AFB
Comments/Description: Cased in concrete

Site Rated by: E H Snider, H D Harman

I. RECEPTORS

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
A. Population within 1,000 feet of site	3	4	12	12
B. Distance to nearest well	0	10	0	30
C. Land use/zoning within 1 mile radius	2	3	6	9
D. Distance to reservation boundary	3	6	18	18
E. Critical environments within 1 mile radius of site	1	10	10	30
F. Water quality of nearest surface water body	0	6	0	18
G. Ground water use of uppermost aquifer	1	9	9	27
H. Population served by surface water supply within 3 miles downstream of site	0	6	0	18
I. Population served by ground-water supply within 3 miles of site	0	6	0	18
Subtotals			55	180

Receptors subscore (100 x factor score subtotal/maximum score subtotal) 31

II. WASTE CHARACTERISTICS

A. Select the factor score based on the estimated quantity, the degree of hazard, and the confidence level of the information.

1. Waste quantity (1=small, 2=medium, 3=large) 1
2. Confidence level (1=confirmed, 2=suspected) 2
3. Hazard rating (1=low, 2=medium, 3=high) 1

Factor Subscore A (from 20 to 100 based on factor score matrix) 20

B. Apply persistence factor
Factor Subscore A x Persistence Factor = Subscore B

20 x 1.00 = 20

C. Apply physical state multiplier
Subscore B x Physical State Multiplier = Waste Characteristics Subscore

20 x 0.50 = 10

III. PATHWAYS

A. If there is evidence of migration of hazardous contaminants, assign maximum factor subscore of 100 points for direct evidence or 80 points for indirect evidence. If direct evidence exists then proceed to C. If no evidence or indirect evidence exists, proceed to B.

Subscore 0

B. Rate the migration potential for 3 potential pathways: surface water migration, flooding, and ground-water migration. Select the highest rating and proceed to C.

Rating Factor	Factor Rating (0-3)	Multi-plier	Factor Score	Maximum Possible Score
1. Surface Water Migration				
Distance to nearest surface water	3	8	24	24
Net precipitation	0	6	0	18
Surface erosion	0	8	0	24
Surface permeability	1	6	6	18
Rainfall intensity	2	8	16	24
Subtotals			46	108
Subscore (100 x factor score subtotal/maximum score subtotal)				43
2. Flooding	0	1	0	3
Subscore (100 x factor score/3)				0
3. Ground-water migration				
Depth to ground water	3	8	24	24
Net precipitation	0	6	0	18
Soil permeability	2	8	16	24
Subsurface flows	1	8	8	24
Direct access to ground water	1	8	8	24
Subtotals			56	114
Subscore (100 x factor score subtotal/maximum score subtotal)				49

C. Highest pathway subscore.

Enter the highest subscore value from A, B-1, B-2 or B-3 above.

Pathways Subscore 49

IV. WASTE MANAGEMENT PRACTICES

A. Average the three subscores for receptors, waste characteristics, and pathways.

Receptors	31	
Waste Characteristics	10	
Pathways	49	
Total	90 divided by 3 =	30 Gross total score

B. Apply factor for waste containment from waste management practices.

Gross total score x waste management practices factor = final score

30 x 0.10 = 3

FINAL SCORE

APPENDIX I

REFERENCES

APPENDIX I
REFERENCES

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APPENDIX J

GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

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GLOSSARY OF TERMINOLOGY AND ABBREVIATIONS

ABG: Air Base Group

ACFT MAINT: Aircraft Maintenance.

AF: Air Force.

AFB: Air Force Base.

AFESC: Air Force Engineering and Services Center.

AFFF: Aqueous Film Forming Foam, a fire extinguishing agent.

AFR: Air Force Regulation.

Ag: Chemical symbol for silver.

AGE: Aerospace Ground Equipment.

Al: Chemical symbol for aluminum.

ALLUVIUM: Materials eroded, transported and deposited by streams.

ALLUVIAL FAN: A fan-shaped deposit formed by a stream either where it issues from a narrow mountain valley into a plain or broad valley, or where a tributary stream joins a main stream.

ANTICLINE: A fold in which layered strata are inclined down and away from the axes.

ARTESIAN: Ground water contained under hydrostatic pressure.

AQUIFER: A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

AROMATIC: Description of organic chemical compounds in which the carbon atoms are arranged into a ring with special electron stability associated. Aromatic compounds are often more reactive than non-aromatics.

ATC: Air Training Command.

AVGAS: Aviation Gasoline.

Ba: Chemical symbol for barium.

BEE: Bioenvironmental Engineer.

BES: Bioenvironmental Engineering Services.

BIOACCUMULATE: Tendency of elements or compounds to accumulate or build up in the tissues of living organisms when they are exposed to these elements in their environments, e.g., heavy metals.

BIODEGRADABLE: The characteristic of a substance to be broken down from complex to simple compounds by microorganisms.

BOWSER: A portable tank, usually under 200 gallons in capacity.

BX: Base Exchange.

$CaCO_3$: Chemical symbol for calcium carbonate.

CALIBRATING FLUID: Oil based solution.

CAMS: Consolidated Aircraft Maintenance Squadron.

CARBON REMOVER: Organic cleaning agent.

Cd: Chemical symbol for cadmium.

CE: Civil Engineering.

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act.

CES: Civil Engineering Squadron.

CIRCA: About; used to indicate an approximate date.

CLEANING FLUIDS: Organic and alkaline cleaners.

CLOSURE: The completion of a set of rigidly defined functions for a hazardous waste facility no longer in operation.

CMS: Component Maintenance Squadron.

CN: Chemical symbol for cyanide.

COD: Chemical Oxygen Demand, a measure of the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in water.

COE: Corps of Engineers.

CONFINED AQUIFER: An aquifer bounded above and below by impermeable strata or by geologic units of distinctly lower permeability than that of the aquifer itself.

CONFINING UNIT: A geologic unit with low permeability which restricts the movement of ground water.

CONTAMINATION: The degradation of natural water quality to the extent that its usefulness is impaired; there is no implication of any specific limits since the degree of permissible contamination depends upon the intended end use or uses of the water.

CORROSION REMOVER: Alkaline cleaning solution.

Cr: Chemical symbol for chromium.

Cu: Chemical symbol for copper.

2,4-D: Abbreviation for 2,4-dichlorophenoxyacetic acid, a common weed killer and defoliant.

DEQPPM: Defense Environmental Quality Program Policy Memorandum

DET: Detachment.

DIP: The angle at which a stratum is inclined from the horizontal.

DISPOSAL FACILITY: A facility or part of a facility at which hazardous waste is intentionally placed into or on land or water, and at which waste will remain after closure.

DISPOSAL OF HAZARDOUS WASTE: The discharge, deposit, injection, dumping, spilling, or placing of any hazardous waste into or on land or water so that such waste or any constituent thereof may enter the environment or be emitted into the air or discharged into any waters, including ground water.

DOD: Department of Defense.

DOT: Department of Transportation

DOWNGRADIENT: In the direction of decreasing hydraulic static head; the direction in which ground water flows.

DPDO: Defense Property Disposal Office, previously included Redistribution and Marketing (R&M) and Salvage.

DUMP: An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics; dumps are susceptible to open burning and are exposed to the elements, disease vectors and scavengers.

EFFLUENT: A liquid waste discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment.

EMULSIFIER: Organic solution used in NDI operation.

EP: Extraction Procedure, the EPA's standard laboratory procedure for leachate generation.

EPA: U.S. Environmental Protection Agency.

EPHEMERAL AQUIFER: A water-bearing zone typically located near the surface which normally contains water seasonally.

EROSION: The wearing away of land surface by wind, water, or chemical processes.

ES: Engineering-Science, Inc.

FAA: Federal Aviation Administration.

FACILITY: Any land and appurtenances thereon and thereto used for the treatment, storage and/or disposal of hazardous wastes.

FAULT: A fracture in rock along which the adjacent rock surfaces are differentially displaced.

Fe: Chemical symbol for iron.

FINGERPRINT REMOVER: Organic solvent.

FIXER SOLUTION: Photographic solution containing silver.

FLDTG: Field Training Group

FLOOD PLAIN: The lowland and relatively flat areas adjoining inland and coastal areas of the mainland and off-shore islands, including, at a minimum, areas subject to a one percent or greater chance of flooding in any given year.

FLOW PATH: The direction or movement of ground water as governed principally by the hydraulic gradient.

FMS: Field Maintenance Squadron.

FPTA: Fire Protection Training Area.

FREON: Highly volatile cleaning solvent.

FTW: Flying Training Wing

FY: Fiscal Year

GC/MS: Gas chromatograph/mass spectrophotometer, a laboratory procedure for identifying unknown organic compounds.

GROUND WATER: Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure.

GROUND-WATER RESERVOIR: The earth materials and the intervening open spaces that contain ground water.

HALON: A fluorocarbon fire extinguishing compound.

HALOGEN: The class of chemical elements including fluorine, chlorine, bromine, and iodine.

HARDFILL: Disposal sites receiving construction debris, wood, miscellaneous spoil material.

HARM: Hazard Assessment Rating Methodology.

HAZARDOUS SUBSTANCE: Under CERCLA, the definition of hazardous substance includes:

1. All substances regulated under Paragraphs 311 and 307 of the Clean Water Act (except oil);

2. All substances regulated under Paragraph 3001 of the Solid Waste Disposal Act;

3. All substances regulated under Paragraph 112 of the Clean Air Act;

4. All substances which the Administrator of EPA has acted against under Paragraph 7 of the Toxic Substance Control Act;

5. Additional substances designated under Paragraph 102 of the Superfund bill.

HAZARDOUS WASTE: As defined in RCRA, a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical or infectious characteristics may cause or significantly contribute to an increase in mortality or an increase in serious, irreversible, or incapacitating reversible illness; or pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed.

HAZARDOUS WASTE GENERATION: The act or process of producing a hazardous waste.

HEAVY METALS: Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations but which become toxic at higher concentrations.

Hg: Chemical symbol for mercury.

HQ: Headquarters.

HWAP: Hazardous Waste Accumulation Point

HWMF: Hazardous Waste Management Facility.

HYDROCARBONS: Organic chemical compounds composed of hydrogen and carbon atoms chemically bonded. Hydrocarbons may be straight chain, cyclic, branched chain, aromatic, or polycyclic, depending upon arrangement of carbon atoms. Halogenated hydrocarbons are hydrocarbons in which one or more hydrogen atoms has been replaced by a halogen atom.

INCOMPATIBLE WASTE: A waste unsuitable for co-mingling with another waste or material because the commingling might result in generation of extreme heat or pressure, explosion or violent reaction, fire, formation of substances which are shock sensitive, friction sensitive, or otherwise have the potential for reacting violently, formation of toxic dusts, mists, fumes, and gases, volatilization of ignitable or toxic chemicals due to heat generation in such a manner that the likelihood of contamination of ground water or escape of the substance into the environment is increased, any other reaction which might result in not meeting the air, human health, and environmental standards.

INFILTRATION: The movement of water through the soil surface into the ground.

IRP: Installation Restoration Program.

ISOPACH: Graphic presentation of geologic data, including lines of equal unit thickness that may be based on confirmed (drill hole) data or indirect geophysical measurement.

JP-4: Jet Propulsion Fuel Number Four, military jet fuel.

LBR: Local Base Rescue

LEACHATE: A solution resulting from the separation or dissolving of soluble or particulate constituents from solid waste or other man-placed medium by percolation of water.

LEACHING: The process by which soluble materials in the soil, such as nutrients, pesticide chemicals or contaminants, are washed into a lower layer of soil or are dissolved and carried away by water.

LENTICULAR: A bed or rock stratum or body that is lens-shaped.

LINER: A continous layer of natural or man-made materials beneath or on the sides of a surface impoundment, landfill, or landfill cell which restricts the downward or lateral escape of hazardous waste, hazardous waste constituents or leachate.

LITHOLOGY: The description of the physical character of a rock.

LOESS: An essentially unconsolidated unstratified calcareous silt; commonly homogeneous, permeable and buff to gray in color.

LOX: Liquid oxygen.

LYSIMETER: A vacuum operated sampling device used for extracting pore water samples at various depths within the unsaturated zone.

MAC: Military Airlift Command.

MEK: Methyl Ethyl Ketone.

METALS: See "Heavy Metals".

METHANOL: Methyl Alcohol (combustible).

MGD: Million gallons per day.

MOA: Military Operating Area.

MIK: Methyl isobutyl ketone.

MOGAS: Motor gasoline.

Mn: Chemical symbol for manganese.

MODIFIED MERCALLI INTENSITY: A number describing the effects of an earthquake on man, structures and the earth's surface. A Modified Mercalli Intensity of I is not felt. An intensity of VI is felt indoors and outdoors and for an intensity of VII it becomes difficult for a man to remain standing. Intensities of IX to XII involve increasing levels of destruction with destruction being nearly total at an intensity of XII.

MONITORING WELL: A well used to measure ground-water levels and to obtain samples.

MSL: Mean Sea Level.

MWR: Morale, Welfare and Recreation.

NCO: Non-commissioned Officer.

NCOIC: Non-commissioned Officer In-Charge.

NDI: Non-destructive inspection.

NET PRECIPITATION: The amount of annual precipitation minus annual evaporation.

NGVD: National Geodetic Vertical Datum of 1929.

Ni: Chemical symbol for nickel.

NOAA: National Oceanic and Atmospheric Administration

NPDES: National Pollutant Discharge Elimination System.

OEHL: Occupational and Environmental Health Laboratory.

OIC: Officer-In-Charge.

ORGANIC: Being, containing or relating to carbon compounds, especially in which hydrogen is attached to carbon.

OSI: Office of Special Investigations.

O&G: Symbols for oil and grease.

PATHOLOGICAL WASTES: Hospital waste which could potentially be contaminated with disease carrying organisms.

Pb: Chemical symbol for lead.

PCB: Polychlorinated Biphenyl; liquids used as a dielectrics in electrical equipment.

PENETRANT: Organic solution used in NDI operation.

PERCOLATION: Movement of moisture by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

PERMEABILITY: The capacity of a porous rock, soil or sediment for transmitting a fluid without damage to the structure of the medium.

PERSISTENCE: As applied to chemicals, those which are very stable and remain in the environment in their original form for an extended period of time.

PD-680: Cleaning solvent.

pH: Negative logarithm of hydrogen ion concentration.

PL: Public Law.

POL: Petroleum, Oils and Lubricants.

POLLUTANT: Any introduced gas, liquid or solid that makes a resource unfit for a specific purpose.

POLYCYCLIC COMPOUND: All compounds in which carbon atoms are arranged into two or more rings, usually aromatic in nature.

POTENTIALLY ACTIVE FAULT: A fault along which movement has occurred within the last 25-million years.

POTENTIOMETRIC SURFACE: The surface to which water in an aquifer would rise in tightly cased wells open only to the aquifer.

PPB: Parts per billion by weight.

PPM: Parts per million by weight.

PRECIPITATION: Rainfall.

QUATERNARY MATERIALS: The second period of the Cenozoic geologic era, following the Tertiary, and including the last 2-3 million years.

RCRA: Resource Conservation and Recovery Act.

RECEPTORS: The potential impact group or resource for a waste contamination source.

RECHARGE AREA: A surface area in which surface water or precipitation percolates through the unsaturated zone and eventually reaches the zone of saturation. Recharge areas may be natural or manmade.

RECHARGE: The addition of water to the ground-water system by natural or artificial processes.

RIPARIAN: Living or located on a riverbank.

SAAS: School of Applied Aerospace Sciences

SANITARY LANDFILL: A land disposal site using an engineered method of disposing solid wastes on land in a way that minimizes environmental hazards.

SATURATED ZONE: That part of the earth's crust in which all voids are filled with water.

SAX'S TOXICITY: A rating method for evaluating the toxicity of chemical materials.

SCS: U.S. Department of Agriculture Soil Conservation Service.

SEISMICITY: Pertaining to earthquakes or earth vibrations.

SHCS: School of Health Care Sciences

SLUDGE: Any garbage, refuse, or slude from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SOLID WASTE: Any garbage, refuse, or sludge from a waste treatment plant, water supply treatment, or air pollution control facility and other discarded material, including solid, liquid, semi-solid, or contained gaseous material resulting from industrial, commercial, mining, or agricultural operations and from community activities, but does not include solid or dissolved materials in domestic sewage; solid or dissolved materials in irrigation return flows; industrial discharges which

are point source subject to permits under Section 402 of the Federal Water Pollution Control Act, as amended (86 USC 880); or source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954 (68 USC 923).

SPILL: Any unplanned release or discharge of a hazardous waste onto or into the air, land, or water.

STORAGE OF HAZARDOUS WASTE: Containment, either on a temporary basis or for a longer period, in such a manner as not to constitute disposal of such hazardous waste.

STP: Sewage Treatment Plant.

STTC: Sheppard Technical Training Center

2,4,5-T: Abbreviation for 2,4,5-trichlorophenoxyacetic acid, a common herbicide.

TCE: Trichloroethylene.

TCHTW: Technical Training Wing

TDS: Total Dissolved Solids, a water quality parameter.

TOC: Total Organic Carbon.

TOXICITY: The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

TRANSMISSIVITY: The rate at which water is transmitted through a unit width of aquifer under a unit hydraulic gradient.

TREATMENT OF HAZARDOUS WASTE: Any method, technique, or process including neutralization designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize the waste or so as to render the waste nonhazardous.

TRICHLOROETHANE: Organic degreaser solvent.

TRICHLOROETHYLENE: Organic degreaser solvent.

TSD: Treatment, storage or disposal.

TSDF: Treatment, storage or disposal facility.

TTG: Technical Training Group.

UPGRADIENT: In the direction of increasing hydraulic static head; the direction opposite to the prevailing flow of ground water.

USAF: United States Air Force.

USAFSS: United States Air Force Security Service.

USDA: United States Department of Agriculture.

USFWS: United States Fish and Wildlife Service.

USE PERMIT: Authority to allow use of federal property by a federal agency without monetary exchange.

USGS: United States Geological Survey.

WATER TABLE: Surface of a body of unconfined ground water at which the pressure is equal to that of the atmosphere.

WWTP: Wastewater Treatment Plant.

Zn: Chemical symbol for zinc.

APPENDIX K

INDEX

APPENDIX K
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